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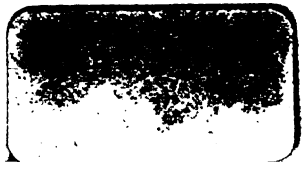

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VOL. V.] [PART I.

TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY

EDINBURGH

PRINTED FOR THE ARBORICULTURAL SOCIETY

BY EDWARD RAVENSCROFT

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INTRODUCTION.

IN submitting to the Members of the SCOTTISH ARBORICULTURAL SOCIETY the First Part of a New Volume of the *Transactions*, the Editing Committee have much pleasure in stating that the materials at their disposal for the formation of this Volume exceed, in point of variety of subject and interest, those of any previous issue of the Society. This fact evinces the increasing interest taken by Members in the welfare of the Association; and while the Editing Committee thus gratefully acknowledge the alacrity with which Members have aided them in their endeavours to render the *Transactions* of the Society of greater importance, and more attractive than hitherto, as well as more worthy of the objects for which the Society was instituted fifteen years ago, and of the position it holds as the only National Association of the kind for the advancement and study of Arboriculture;—they earnestly desire to impress upon every Member the necessity for steady and well-sustained individual exertions to promote the interests of the Society, by inducing new recruits to aid the Society's endeavours,—no less by their influence and membership, than by their contributions to its publications.

It is satisfactory to observe the continued increase, year by year, in the Roll of Members. At the date of the commencement of the last Volume of these *Transactions* in 1866, the Society numbered only 168, while at the present date, it can boast of a Roll of 348 Members. While thus congratulating the Society on the favour and patronage which is being bestowed upon it, the Editing Committee hope that the success which has attended it during the past may act as a stimulus to still greater exertions in the future.

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The Editing Committee would only further call the attention of the Members of the Society to the improved and enlarged form in which the *Transactions* now appear. They have deemed it advisable,—while adhering to the old motto and title-page of the *Transactions*,—to extend the size of the publication, and adopt a new and better type, printed in double column,—an improvement which they hope the Members of the Society will find of much importance, inasmuch as, besides being more easily read, the double column is better adapted for the introduction of woodcuts, which authors of such papers as appear in a Journal of this kind frequently find necessary to illustrate their remarks. And in addition to these advantages in the appearance of the New Series of the *Transactions*, there is another gain obtained by the change, and which the Editing Committee think the Members of the Society will not consider the least important part of the matter, namely, that by an arrangement made with Mr RAVENSCROFT, who will in future publish the *Transactions* for the Society, there will be a very considerable annual pecuniary saving in the cost of printing, &c., over former years, which will enable a larger portion of the revenue of the Society to be devoted to the extension and advancement of the Society's objects in promoting the Science of Arboriculture, in such other departments and fields of labour and research as may, from time to time, present themselves.

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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

I.—*ADDRESS DELIVERED AT THE FIFTEENTH ANNUAL GENERAL MEETING.*

BY ROBERT HUTCHISON OF CARLOWRIE, PRESIDENT.

GENTLEMEN,—I observe by the billet summoning this meeting, that I am expected, as President of this Society, to deliver an Address on the occasion of re-entering upon another year's duties. I shall most willingly fulfil this expectation, and while I sincerely wish, for the sake of this audience, as well as for the general good of the Scottish Arboricultural Society, that the task of delivering the Inaugural Address fell to a more able chairman than myself, and to one in whose hands full justice could be done to the subject of arboricultural science, and to its claims upon the notice and study of intelligent observers, I am sure, gentlemen, that in the few brief and hurried remarks which I address to you, and which cannot, without much presumption, arrogate to themselves the title of an "Inaugural Address," you will bear with me in their imperfections, and believe that in making them, I do so with the best intention, and good wishes for the continued welfare of our Society. And first of all, gentlemen, allow me to thank you most sincerely for the honour you have to-day done me in re-electing me, for the fourth time, President of the Scottish Arboricultural Society. If anything were wanting, in my mind, to interest me in your prosperity and welfare, and to induce me to aid you in my humble way by my best endeavours to promote these and the interests of arboriculture as a national subject, it is the unanimous vote of confidence you have annually, for the past few years, been pleased to pass upon my services as your President, no less than the uniform kind and indulgent support given me by all the Office-bearers and Members of this Society who are able to attend our annual meetings, and whose number, judging from this audience to-day, is in no degree decreasing. It is most encouraging to see so many Members from distant quarters doing their duty to the Society, by coming so far, year by year, to our annual gathering; and it affords further proof, that however remiss, in past years, many of the Members of the Society may have been, there is a spirit of vigour infusing itself into our ranks, which, you will agree with me, augurs well for our future. Nor does the attendance only of the members at the November meeting give us ground of confidence of the position which I maintain, this society must, ere long, take as a national institution, whose labours will be appreciated, and whose sons will be known and professionally sought after in other climes than those of the oak and the pine. Yes, gentlemen, I believe that the Indian Empire with its teeming forests and lucrative appointments lies before such of you as desire to embark on the enterprise; and I hope, ere long, we may as a Society be able to suggest some plan, and submit it to the proper

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quarter, by which Members of this Association may obtain better chances of gleaning the golden fruits of such lucrative and honourable appointments. I shall gladly aid and endeavour to do this, gentlemen, from confidence in the ability of many of those I see around me, and of other Members of the Society, whom I ever deem it a proud honour to represent, and knowing, as I do, the thoroughly practical right good stuff of which this Society is composed.

And now, gentlemen, I must make a few remarks upon one incident which occurred during the past year. In the course of the summer, my friend Mr Brown, of Invercauld, (to whom this Society, I assure you, is under a deep debt of gratitude for his assiduous endeavours to forward the cause of arboriculture, and his able and eloquent appeals in its behalf), wrote me to ask if I would attend the meeting of the British Association at Norwich, in August, with him, to do what we could with that august assemblage of scientific thinkers, to obtain for arboriculture, recognition as one of the exact sciences. I agreed most willingly to go, if the Members of the General Committee of the Society wished me. Mr Brown wrote to the individual Members of that Committee on the subject; and their replies were so harmonious, that no doubt was left on my mind that I would be failing in my duty to the Society, as its President, if I did not at once give effect to the suggestion of Mr Brown. Our hopes were further heightened of a successful mission, seeing that Dr Hooker of Kew was the President elect of the British Association. At Norwich, a most excellent paper was read by Mr Brown upon the claims of arboriculture as a science, following well up what he had read the previous year at the Dundee meeting of the Association; and in Committee in Section D (Biology), I brought forward a representation in your behalf, asking a grant of £50 from the British Association, to be expended by us in definitely fixing, by a series of experiments over the country, through our members, the temperature of woods, and the temperature of the same situations after the timber had been felled. This application had the approval of the Sectional Committee, in which it was kindly supported by Professor Balfour and Dr Cleghorn; but, unfortunately, when sent up to the higher tribunal of the Committee of Reference, it was rejected, for the present at any rate. I am in hopes, however, that the matter, meeting with the favour it has done, is not finally thrown overboard; and I shall shortly communicate with Dr Hooker again on the subject, and revive it, if you wish me, at the British Association meeting at Exeter next year.

If we should be successful, gentlemen, as I hope we shall be, the series of experiments or rather observations, which will have to be made at various stations, if accurately taken, will be eminently interesting, curious, and useful. It is a subject which merits our closest attention as a Society, and affects the daily operations of every forester amongst us. For, if I may so speak, each practical forester has a double faculty allotted him in his sphere of duty; he creates and he destroys; and the man of science has to deal with what he *does* and what he *undoes*. The modes of operation, in each instance, are often so indirect, and, alas! sometimes so little guided by reason or intention, that though they occasionally happen to be blended with the spontaneous operations of nature herself, the conclusions we arrive at are frequently at fault, even on points of the greatest practical interest.* Hence the need for scientific investigation and accurate observation, that in the arboricultural world we may learn, and apply to practical purpose, to what extent, as affecting the climate of a locality, and hence its salubrity, fertility, and health, does man's power over the conditions of the natural world around him reach; and to shew what in different localities has been done, or may yet be done, in effect of this power.

The atmosphere, the waters, evaporations, the superficial crust of the earth, and its upper strata, are the portions of the material inorganic world with which every practical Member of this Society is not only in his own locality well acquainted, but it is these that

* *Vide* "Edinburgh Review," vol. cxx., No. ccxlvi., "Man and Nature," p. 469.

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he taxes his intelligence and brain to govern or control, through the existence of the active powers of nature—light, heat, electricity, gravitation, &c.—and hence these become the instruments with which he works in his profession, no less than he does with the spade, the axe, the pruning-knife, or other implements. Therefore it is that I would impress upon every Member of this Society the necessity of giving a more scientific inquiry and study to the details of his profession; — to the *why* and the *wherefore* of the many beautiful phenomena of nature which must frequently present themselves in the forest-world to the most casual observer; — to the "where, whence, and whither" of many of the rare objects of surpassing loveliness that occur in the arboricultural world, from the exquisite fossil remains of coniferæ to be found in the coal measures at the present day throughout Scotland and England, resembling, if they are not identical with, the Araucaria of (as we term it) *recent* introduction;—to the newly imported Japanese curiosities of the present time, or to the future destiny in our country of the massive trunks of the Wellingtonia, and other late, and what promise to be, valuable acquisitions to our British Sylva. Inquiry into such subjects is replete with interest and profit to the forester in his leisure hours, which may be turned to good account in his daily work-a-day life; and in the present day, when we hear so much of Technical Education—when, on every hand, the strides of intelligence are so rapid, and search after truth by experiment and strict induction is so much the rule of all science—it will be well for us as a Society that we should go forward in the van of progress in our special department of scientific observation and discovery. And I would have you bear in remembrance, gentlemen, that all advice I can give you, and all the theories that I may propound, should be used by you but as mere counters or indicators to be laid aside or changed, when they have fulfilled their purpose; and when the search, which they may have been the means of inducing you, or any one of you, to make, after deeper and truer knowledge, has led you to form your own opinions, and to rely in all your enterprises upon your own tried, approved, and independent judgment.

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II.—*ON THE CONIFERÆ AND EVERGREENS RECENTLY INTRODUCED FROM JAPAN, WITH REFERENCE TO THEIR HARDINESS AND SUITABILITY TO THE CLIMATE OF SCOTLAND.*

BY ROBERT HUTCHISON OF CARLOWRIE.

EVERYTHING that is remarkable for beauty and interest in the Flora and Sylva of the British islands at the present day, may be traced to a warmer climate. As the products of the far East have contributed, in a commercial point of view, along with those of every clime where British enterprise and capital have penetrated, to enrich our material wealth, so the Flora and Sylva of every country to which the flag of England has been carried, have assisted, to an extent which it is impossible to exaggerate, to replenish the scanty Sylva of the British isles.

While this is true of flowering and half-hardy herbaceous plants, it is no less the case with shrubs and trees, whether evergreen or deciduous. And confining our remarks in the present paper to coniferous and evergreen trees and shrubs of more recent introduction, and consequently of less thoroughly acclimatized nature and tried hardiness, we may be pardoned if we speak of the various Japanese kinds with somewhat of reserve; for, owing to the short time these have been in cultivation in this country, though they seem to be succeeding well, and proving valuable auxiliaries to the arborist in his selection of striking and beautifully foliaged trees and shrubs, it is quite possible, although, we think, improbable, that upon a more extended trial and wide-spread introduction, some of those we name and quote as having hitherto proved hardy, may result in partial failures.

The introduction of what are now popularly styled "the newer coniferæ," may be classed under six epochs. And although, properly speaking, the dates of these periods go back into years which can hardly, with strict propriety, be termed "recent," it is better to embrace the whole catalogue of coniferous trees flourishing as, or destined to become, timber in Scotland at the present day, in one classification, than merely to notice the new varieties of coniferæ, whose introduction into this country has taken place within the last forty or fifty years.

Starting with the fact that the only indigenous conifer in Scotland is the Scotch Fir (Pinus sylvestris), we find that the first additions made to this solitary cone-bearer were brought to this country from about the middle to the end of the sixteenth century, when we find notices of the existence of the Norway spruce (Abies excelsa); the stone pine of Italy (Pinus pinea); the cypress of Southern Europe (Cupressus sempervirens); and the pinaster or cluster pine (Pinus pinaster); and with the introduction of the larch (Larix Europæa), which took place about the year 1600, we may close the first epoch in the cultivation of coniferæ in Great Britain.

The second epoch in the history of the attempts to cultivate the pine family in the British islands, may be dated from the introduction of the silver fir (Picea pectinata), from the European continent in the year 1603. This second chapter in the lives of the coniferæ is remarkable and interesting, as containing the first notice of specimens brought from beyond the limited confines of Europe; for, shortly after the arrival of the silver fir in this country, we find mention of the existence at Kensington of the deciduous or Mexican cypress (Taxodium distichum Mexicanum); and about the same time, or a few years later, about 1665, the arrival is chronicled of the East Indian cedar of Goa, and also of the now well known cedar of Lebanon (Cedrus Libani).

From the beginning of the eighteenth cen-

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tury we date the third epoch in the history of the introduction of rare coniferæ, when a new field presented itself in our American colonies, whence to draw these novelties, and to gratify the taste for them which was now thoroughly awakened throughout this country. This third epoch contains probably the most valuable acquisitions yet received, if we except those of the *first* period, which, being from the adjacent continent of Europe, and experiencing comparatively little change of climate or geographical position, have all proved quite as hardy as the native Scotch fir; though, indeed, geological discoveries seem to render it probable that in remote eras these conifers were also indigenous to the British islands. To this epoch we refer the introduction of the following species and varieties:—

The white spruce—Abies alba, in 1700.
Black spruce—Abies nigra, in 1700.
Weymouth pine—Pinus Strobus, in 1705.
Frankincense pine—P. Tæda, in 1713.
Banksian pine—P. Banksiana, in 1730.
Hemlock spruce—Abies Canadensis, in 1735
Jersey pine—Pinus inops, in 1738.
American larch—Larix microcarpa, in 1740.
Prickly pine—Pinus pungens, in 1740.
Red spruce—Abies rubra, in 1750.
Resinous pine—Pinus resinosa, in 1750.
Pitch pine—P. rigida, in 1755.
Corsican pine—P. Laricio, in 1760.

A long interval now elapsed, in which little attention seems to have been directed to the further introduction of evergreen shrubs and trees; and until the years from 1825-30, we find no noteworthy varieties introduced. About that time, however, we notice the commencement of the third and most important epoch in the interesting account of the transference of new species of coniferous trees to this country from foreign climes; for to this date we trace the first notice of the now well known and universally appreciated Cedrus deodara. The importation of this popular pine from the Himalayas of India gave an impetus to further research, and as the aid afforded by the East India Company secured a large supply of seeds, while the reported value of the timber of the deodara was accepted as a fact, and its hardiness seemed beyond doubt, several other varieties of Himalayan coniferæ and evergreens soon followed; and about the same period, if not twenty years earlier, we find mention of the Pinus Pallasiana, P. Calabrica, and P. Canariensis, P. Austriaca, P. pyrenaica, and Picea Cephalonica, P. pichta, and Abies Khutrow.

The fifth epoch contains those species introduced from California and Mexico, and embraces the many important additions made to our Pineta from these countries, between the years 1830 and 1855, the history of whose first appearance need not here be more fully detailed, existing as it does in the memory and experience of many of the present generation of foresters and planters, and comprising the well-known names of—

Pinus ponderosa, .	1828 to 1835
Abies Douglasii, .	1828 to 1830
Pinus monticola, .	1830 to 1835
P. Lambertiana, .	1828 to 1830
Picea amabilis, .	1830
Picea grandis, .	1830
Picea nobilis, .	1830
Abies Menziesii, .	1832
Pinus Sabiniana, .	1832
Picea bracteata, .	1833
Pinus insignis, .	1834
Taxodium sempervirens	1840
Wellingtonia gigantea,	1852
Cupressus Lawsoniana,	1853

The sixth and last of the great epochs into which we divide the narrative of the successive introductions and researches after new varieties of pines likely to prove hardy and suitable to the climate of Great Britain, is that which more especially concerns the subject of this paper. It comprises the species more recently introduced from Japan; and beautiful and attractive as many of the denizens of other localities have proved when interspersed with the commoner shrubs in this country, we find amongst these later arrivals, trees whose tiny heads are making bold attempts to start into hardy habits, and

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giving promise that at no distant day they will prove as valuable and useful acquisitions as any which our pleasure-grounds and woodlands have previously received from other countries.

To speak of the thorough hardiness in Scotland of the lately-introduced Japanese coniferæ and evergreens would certainly be premature, inasmuch as many of the young plants reared from the seeds sent home by Mr R. Fortune, and his able rival in arboricultural research, Mr J. G. Veitch, have had too short a trial in the open air to judge of their ability to withstand our long winters and short summers; but in so far as we have had opportunities of judging, we think it may be safely stated that most of those introduced have proved hardy, and with ordinary care in selecting suitable sites, and giving proper treatment until they become acclimatised, there is every probability of their introduction into any collection proving thoroughly successful; while their fine foliage, distinct habits, and novel appearance, render them highly desirable for every Pinetum, and generally attractive to the most cursory observer of arboriculture.

Until the commercial treaty of 1854 opened the Japanese ports to British commerce, the Sylva of that country was comparatively unknown to us; but since that time, sufficient knowledge of the country has been obtained to ascertain that it is rich in many trees admirably adapted for cultivation, either as ornamental or profitable timber, in the British Islands. Nor is there anything in the geographical situation of Japan, or in the nature of the climate or soil, to induce the idea that the further and more extended introduction of these would be attended with any other result than a successful one. We have the experience of previously introduced specimens from other countries before us to guide us, in the present case, in treating carefully those strangers to our climate, whom we wish to adopt and nurture as natives; and if we look at the position of Japan on the globe relatively to our own, we may confidently state that no enterprise gives greater probability of triumphant success, than the introduction of many of the Japanese coniferæ.

It may be necessary to recapitulate briefly a few of the more interesting physical features of this hitherto comparatively unknown country, as bearing upon the probability of such plants as suit its soil and climate, and are indigenous there, being found likely to thrive in the soil and climate of Great Britain.

Situated between latitude 26° and 50° North, and longitude 128° and 151° East, the islands of Japan are exposed to terrific hurricanes. This position in latitude does not differ materially from that of Great Britain, which lies between 50° and 58° North. The situation of both countries is insular—another important feature taken in connexion with tidal currents affecting similarly the vegetation of both. A chain of mountains traverses the islands, which have their summits snow-clad for several months in winter, with a few permanent patches, such as may be seen in some of the crevices of Scotch Highland scenery. Though the character of the country is mountainous, the elevations are generally moderate, and are either cultivated to their summits, or clothed with woods. In the plains of the volcanic region, the earth is generally a rich loam, several feet in depth, without a stone, rendered even more fertile by the liquid manure from the towns. The rest of the soil is sand, enriched by careful manuring. In the northern island of the Japanese group, the winters are long and severe—snow lying from November till May—while the summers are hot. In the southern districts, the winters are milder and of shorter duration. In the variety of its coniferæ, and the large size to which they attain, there is a strong resemblance between Japan and the opposite coast of North America, whence we have obtained so many species, which have proved quite hardy since their introduction into Great Britain; while the greater depth of the soil in Japan induces the belief that the pines brought from that country will prove more

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tap-rooted, and will take a deeper hold of the soil than many of their American brethren, which are very shallow or surface-rooted, and that they will, therefore, be much less liable to suffer injury from the strong winds which prevail in this country, and which have always proved more fatal to the American pines than the severity of our winters has done.

We have said that the instances of successful introduction of the Japanese coniferæ are few, but we should at the same time mention, that where they have been fairly tested they have fulfilled the expectations entertained of them; and, among other examples, we may name the following places where they prove satisfactorily hardy :—

1st. At Rockville, Linlithgowshire, at an elevation of from 220 to 250 feet above the sea level, and upon good soil, inclining to be light, with subsoil of whin-rock and clay, there are fine specimens of the following varieties :—

	Age.	Height.
Cryptomeria elegans...	6 years	6 feet
Cryptomeria Japonica	13 „	15 „
Cryptomeria Lobbii ...	6 „	6 „
Thujopsis dolabrata ...	8 „	2 „
Taxus Japonica.....	13 „	2½ „

There are also fine plants of Cephalotaxus Fortunii, 5 feet high—Juniperus rigida, Retinospora leptoclada, Retinospora obtusa, Retinospora pisifera argentea, and Retinospora pisifera aurea, Sciadopitys verticillata, Thujopsis lætevirens, and Thujopsis Standishii.

These particulars have been obligingly furnished by Mr Adie, C.E., of Rockville, and he further notices that the Cryptomeria viridis is a most beautiful tree, of rapid growth, and of a fine apple-green colour, very useful for contrast in planting. He also states that the Retinospora obtusa promises to be very fine and distinct. The Retinospora aurea and Retinospora pisifera are proving quite hardy, and from their very desirable colour and foliage are vast acquisitions to gardens and pleasure-grounds. The Sciadopitys verticillata is in this situation, as in others we have observed, making very little progress. The finest specimen of that variety is to be found at Osborne. It is one of the originally-introduced plants sent home by Mr Fortune, and is now about two feet in height.

2d. At Sloggery, near Castle-Douglas, elevation above sea level 300 feet, and in loamy soil, there are healthy and hardy plants of Retinospora obtusa, 6 inches in height, and Thujopsis dolabrata, 15 to 18 inches in height. They were planted in 1866, and have stood successfully the very severe frost of March 1867, when the thermometer ranged at 14° in that locality.

3d. At Mount Stuart, in Bute, the Japanese pines seem suited to that climate, and do well.

4th. At Durris, in the county of Kincardine, where there is one of the most extensive and valuable collections of coniferæ to be found in Scotland, the Japanese varieties have been introduced with great and signal success; and although as yet many of the specimens are quite small, and are not growing fast, still their hardiness is undoubted. Growing there at an elevation of 300 feet, in a light loam, upon a subsoil of clay and granite *debris*, we find the following sorts in a healthy and thriving state :—Abies Tsuga, eight years planted, and now 15 feet high; Cryptomeria Japonica, eight years old, and 14 feet high; Cryptomeria viridis, seven years old, and 9 feet high; Cephalotaxus Fortunii, seven years old, and 3 feet high; Retinospora pisifera, two years old, and 3 feet high; Retinospora ericoides, five years old, and 2 feet high; Retinospora obtusa, two years old, and 3 feet 7 in. in height; Thujopsis dolabrata, four years old, and 2 feet high; also smaller plants of Abies polita, Pinus Koraiensis, Pinus densiflora, Sciadopitys verticillata, Thuja falcata, Thujopsis lætevirens, Thujopsis Standishii, and Taxus cuspidata.

The following varieties may be classed as of doubtful hardihood, from the experience of them at Durris :—Abies Kæmpferii, Picea Fortunii, Cunninghamia sinensis, Juniperus rigida, Retinospora leptoclada, Retinospora

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lycopodioides, and Retinospora squarrosa. The last-named plant dies off unaccountably, although it seems hardy during winter. The Abies Kæmpferii grows too late in autumn, and does not ripen its wood well in this situation.

5th. At Carlowrie, Linlithgowshire, in fine deep loam, on a clay subsoil, and at 92 feet elevation, the Taxus Japonica, is 2 feet high; the Cryptomeria Japonica, four and a-half years, and 2 feet high; the Cephalotaxus Fortunii, 3 feet; the Juniperus fragrans (?), 4 feet; and the Cupressus majestica, 2 feet, have all proved quite hardy; while the Pinus densiflora, when four years old, and 2 feet high, died off most unaccountably in an open situation in the middle of summer. The Sciadopitys verticillata is quite hardy at Carlowrie, but a very slow grower. The Thujopsis dolabrata is perfectly hardy, and a great acquisition, indeed one of the best of the Japanese pines; and Retinospora pisifera aurea is quite hardy, and very fine.

6th. At Tortworth Court, Gloucestershire, with an elevation above sea level of 250 feet, upon the old red sandstone and mountain limestone, and on a varied subsoil, we find Lord Ducie has been successful with many of the Japanese pines. For example, the Picea firma, is 2 feet 6 inches in height, very healthy and quite hardy; Abies polita, 2 feet high, also thriving, and of rapid growth; Abies Kæmpferii, ten years old, and 5 feet high, quite healthy and hardy, but slow of growth, and not altogether satisfactory; Cryptomeria Japonica, sixteen years old, 30 feet high, very healthy, quite hardy, of dense habit, and rapid growth in moist soil; Cephalotaxus Fortunii, six years old, and 5 feet high, is quite healthy, of moderate growth, and prefers a moist soil; Retinospora pisifera, four years old, and 5 feet high, is quite hardy, and suits the mountain limestone soil; Retinospora squarrosa, five years old, and 4 feet high, is very healthy and quite hardy, of dense habit when young, but becomes open and branching afterwards. From this station we have likewise returns of Retinospora obtusa and Thuja falcata, both of which are very healthy and free growers, but they are rather small for particular notice.

7th. At Rosehall, Falkirk, elevation 160 feet, on a free loamy soil, we find Cryptomeria Japonica not quite hardy. The same remark applies to Cryptomeria viridis, and we are informed that the Cephalotaxus Fortuni is a bad grower. The Cryptomeria elegans, five years old, and 2 feet in height, is healthy, but very apt to get its young wood destroyed in spring and autumn. In this locality, although of slow growth, Retinospora leptoclada, and Retinospora squarrosa are quite hardy, while Retinospora pisifera, 5 years old, is now 4 feet in height, perfectly healthy, a handsome conifer, and very hardy, indeed one of the best of the Japanese importation. Of the variegated varieties in this collection, we may notice as thriving remarkably well, the Retinospora pisifera argentea, and Retinospora pisifera aurea, both of which are perfectly hardy in this locality, great beauties, and ought to be in every collection. Mr Neilson considers that these are the most handsome conifers which have come from Japan. Retinospora obtusa, five years old, and 4 feet high, is now a great beauty, and perfectly hardy; Sciadopitys verticillata, five years old, and 1 foot high, is quite healthy, but a very slow grower; Thujopsis dolabrata, eight years old, and 1 foot high, is very healthy and handsome, but of slow growth; Taxus Japonica, ten years old, 5 feet high, is very healthy, remarkably fine, and "a gem of the first water."

Although the foregoing examples of successful treatment of the Japanese pines might be multiplied, we think that in the present early stage of the introduction of these plants, enough has been adduced to prove their hardihood, and to encourage others to test their suitability to our climate. In concluding our remarks upon this very interesting subject, we may be permitted to name the following varieties of Japanese coniferæ as worthy of the notice of every admirer of these beautiful trees, all of which, we think, judging from present experience, so far as it

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goes, are likely to prove hardy, and suited to the climate of Great Britain :—

Abies polita.
„ Tsuga.
Cryptomeria elegans.
„ viridis.
„ Japonica.
Cephalotaxus Fortunii.
Juniperus rigida.
„ fragrans.
Picea firma.
Retinospora pisifera.
„ „ argentea.
„ „ aurea.
Sciadopitys verticillata.
Thuja falcata.
Thujopsis dolabrata.
Thujopsis lætevirens.
„ Standishii.
Taxus Japonica.

Of the newer Japanese coniferæ, those which deserve to take the first place as favourites in this country, are—Thujopsis dolabrata, Taxus Japonica, Juniperus fragrans, and Sciadopitys verticillata; and if, as we anticipate, these Japanese novelties are found upon further trial to fulfil the expectations entertained of them, they will soon quite alter the face of the Scotch gardens and pleasure-grounds, and in the words of Mr Isaac Anderson-Henry, whose admiration of all that is novel and deserving of cultivation in arboriculture is well known, "Oh, that we might live to see it!"

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III.—*TREES AND CLIMATE.*

BY WILLIAM BROWN, FACTOR, INVERCAULD.

I HAVE yet to learn that any government or scientific body has ever taken up in a right way those points in the scientific culture of trees, the elucidation of which is so much wanted to guide and assist the practical forester; or those influences, good or bad, which trees are found to possess over the soil and climate, and hence over the health of other vegetation, as well as that of animals.

To the superficial observer there has not perhaps been occasion for any particular notice of a science which many consider as merely a branch of agriculture, and who probably see no cause to give arboriculture an independent standing. I wish then to remove this objection, and to claim for arboriculture that position which I hope to shew its importance eminently deserves, and urgently demands.

What is Arboriculture? To the practical forester it is the production of the best timber at the least cost, in the largest quantity and shortest time. To plant, thin, and clear, for profit, is almost his sole object. The value of woods is yet estimated very much by the amount of their own produce. Such a view of them reminds me of a proprietor who holds ordinary stock in a railway through his lands, and who expects good dividends, besides the many indirect advantages of the increased communication. One so circumstanced would be selfish and unreasonable did he expect five per cent. for his money; and so, those who are dissatisfied with 20s. or 25s. per acre per annum (on averages of soil and kinds of trees) from their wood crops, without reference to climate and health, are equally selfish and unreasonable. I purpose then to shew the value of trees in connexion with climate and health.

A tree, with its branches and leaves, is a bunch of inhaling and exhaling organisms. Evaporation and inhalation goes on from the thin leaves, as they are heated by the sun's rays, or cooled at night, in the same manner as other bodies. Buchan says that trees may be conceived as reservoirs in which the heat of the day is stored up against the cold of the night.

"The effect then of trees on the temperature is to make the nights warmer and the days cooler; and from this it follows that they diminish the summer temperature and maintain that of winter higher than it would otherwise be. This enables us to understand how trees increase the rainfall; for suppose a forest to lower the summer heat of a district to the extent of about 2°, the effect on the rain-bringing winds would be much the same as if a low range of hills opposed their course, and condensed their vapour into rain."

The influences of trees are ascertained in two ways, viz.: in the diminished radiation from the surface protected by trees, and in the obstacles they oppose to the descending currents of cold air. Humboldt says that trees "exhale fluid from their leaves, in the first place, for their own benefit. But various important secondary effects follow from this process. One of them is, maintaining a suitable portion of humidity in the air. Not only do they attract and condense the moisture suspended in the air, and borne by the wind over the earth's surface, which, falling from their leaves, keeps the ground below moist and cool, but they can, by means of their roots, pump it up from a very considerable depth, and, raising it into the atmosphere, diffuse it over the face of the country. Trees, by the perspiration from their leaves, surround themselves with an atmosphere constantly cool and moist. They also shelter the soil from the direct action of the sun, and thus prevent evaporation of the water furnished by rains."

Such, briefly, are the breathing or perspir-

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ing effects of trees upon the atmosphere. There is no want of proof of these effects and I shall give a few examples. At the Cape of Good Hope, Sir John Herschel observed on the side of Table Mountain, from which the wind blew, the clouds spread out, and descend very low, frequently without any rain falling, while on the opposite side they covered the mountain in dense masses of vapour. When walking beneath tall fir-trees at the time those clouds were closely overlaid, he was subjected to a heavy shower of rain, but on going out from beneath the trees, the rain ceased. The explanation he gave of the phenomenon was, that the clouds were condensed into rain on the cool tops of the trees. This is a remarkable illustration of the influence of trees in condensing the vapour of the atmosphere.

The influence of woods upon springs of water is also remarkable. As an instance, Boussingault relates that the Wolf-spring, in the Commune of Conbay, did not exist a few years ago. At the place where it now rises, a small thread of water was observed after very long rains, but the stream disappeared with the rain. This spot is in the middle of a very steep pasture, inclining to the south. Eighty years ago, the owner of the land, perceiving that some firs were shooting up in the upper part of it, determined to let them grow, and they soon formed a flourishing grove. As soon as they were well grown, a fine spring appeared in place of the occasional rill, and furnished abundant water in the longest drought. For forty or fifty years this spring was considered the best in Clos-du-Doulis. A few years ago this grove was felled, and the ground again turned to pasture. The spring disappeared with the wood, and is now as dry as it was ninety years ago.

Again, the present sterility of the once fertile, but now deserted and desolate region of Syria, Barbary, and Chaldea, are familiar instances of forest-clearing. Similar results are being brought about by clearing in Canada.

In early times, when Britain was a country of forests, the seasons were more marked and regular than now under drainage and cultivation.

Most calamitous effects could be instanced, especially in foreign countries, from the reckless sweeping away of forests, whereby destructive inundations are frequent, and the country around has become a waste. There can be no doubt that the want of a due proportion of a country under a tree crop is certain to cause irregularity of temperature, violent storms, and dryness.

On the other hand, a country may be overclothed with wood, so as to bring about just the opposite effects, which, besides their more immediate results, are well known as generators of disease. Indeed, the history of all nations reveals the effects of cutting down their woods and forests, and it is a daily one. In reviewing a French work, in May last, the *Pall Mall Gazette* has the following:—

"In travelling through Spain and the centre of France, there is nothing sadder than to draw a contrast in the imagination between the present treeless tracts and the vast forests which once covered the land. In Spain, miles and miles of tawny monotonous country go by for hours, as you sit in the railway carriage, telling of baking suns and freezing winds, dangerous floods, sudden and violent changes, destructive to human life.

"The great question of replanting forests is now very much considered in Europe; and it is a most important question. Not only does the vast quantity of wood which is consumed in modern civilised life make it so, the question also involves climate and health. Those great inundations which cause such terrible suffering in France would be much mitigated, if not prevented altogether, if the hills and valleys were covered with forests. The seasons themselves would be less intense—the summers less burning, and the winters less freezing. To those who know the north coast of Africa, it is clear that there is nothing more likely to rouse genuine enthusiasm than the prospect of clothing the hills with vegetation, and thus mitigating the terrible effects of sirocco, rendering that beautiful country more healthy

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in the plains, giving it the shade which it requires, absolutely producing rainfalls, and increasing the supply of water from the springs; in one word, changing the meteorological phenomena, and adapting it for men and civilization. Dr Bodichon insists that Africa has a deteriorating effect upon men, principally owing to the irritating effects of the dry air and of the sirocco. And he, moreover, adds in his book that there the ground has done its part, and that the tree must now begin its work."

"Ever since the axe of the European planter vigorously began work on the forest ranges of Western India, alarm has been felt (says the *Madras Times*) for the regular supply of water to the plains. Government have from time to time attempted to investigate the subject, but how to prevent the mischief done by floods at one time of the year, and drought at another, is a matter which they still much wish to discover. It is now well ascertained that the extensive felling of the forests causes this double mischief; and Dr Cleghorn, the officiating inspector of forests, who has recently travelled along the mountain ranges northward from Cape Comouri, points out that the simplest and most practicable method of diminishing, if not preventing these evils, is to replant the bare hillsides. Mr Markham, secretary to the Royal Geographical Society, calculated recently that in Western India a total area of 180,000 acres of forest has been cleared for coffee, tea, and cinchona plantations."

Let us now take this matter home to ourselves, and see how Britain stands in regard to trees and climate.

The area of Great Britain is about 57,000,000 acres, of which it is estimated 2,600,000, or 1-22d part, are under a crop of wood of all kinds and ages; or, more particularly, the whole surface may be divided into five grand divisions, thus:—

	Acres.
Corn crops.....	7,300,000
Green crops	3,500,000
Grass	15,800,000
Wood.....	2,600,000
Uncultivated	25,800,000
	57,000,000

There is, then, in our island, 1 acre in every 22 covered by trees, or only one-third less than what is under green crops. To every 11 acres of cultivated land there is 1 of wood, and 1 to every 16 of uncultivated. The grass land rental of Great Britain being about £53,000,000, or 18s. 6d. per acre overhead, but 30s. when confined to the cultivated; and as a wood crop is found to return as much, on an average, as arable, we find the annual value thereof to be no less than £2,500,000—a financial fact to tell in favour of the object of this paper.

We find, then, there are at present trees enough to make a belt two miles broad all round the coast. This seems large, and if regularly distributed, according to the requirements of districts, it might be found that 1 acre in 22 is sufficient, not only for health and shelter, but also for climatic uses.

Sir Henry James, the head of the Ordnance Survey, estimates that 2½ per cent. is the proportion of wood surface over England, which, with the exception of Portugal, is probably below that of any other country. Of course, the larger the body of land the greater amount of wood is required.

Germany, for instance, requires 20 per cent. for agricultural purposes. France has 17 per cent. under wood, which is found to be too little.

And now for our argument on the whole question.

The practical observer and the man of science agree in the belief that man, to a great extent, can control and regulate certain climatic agencies. In regard to the extent to which this may be done, difference of opinion doubtless exists; but few whose opinion can be of much weight will doubt the fact itself. The attestation of this is strongly maintained by Sir John Herschell.

"There is evidently," he says, "something distinct from mere local situation which determines this element of climate, and one must look for it in the nature of the surface of the district, and its relations to heat and moisture, relations which the operations of man on the soil itself, and his selection of the kind of vegetation with which it shall be habitually clothed, place to a great extent

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within his power. It is chiefly in his clearance and allowance of arborescent vegetation, and in his artificial drainage of the soil that his influence on these relations is perceptible."

I am glad that ideas which I had myself formed by observation should be borne out by this eminent authority.

In the same chapter, Sir John says, "that drainage, if carried to excess, may ere long be very severely felt in rendering large tracts of country uninhabitable in summer for mere want of water."

This remark has particular reference to a paper by Mr Symons, "On the Rainfall of the British Isles," prepared for the British Association in 1865, where the important fact is brought out that the annual mean rainfall is decreasing, on an average, over the whole country to the extent of about 4 per cent. This more especially occurs along a line running S.W. and N.E. from Cornwall to the Wash, and is attributed partly to the universal clearance of timber, and partly to the robbing of the springs by artificial drainage.

To prevent any ill-grounded view of an agricultural improvement so important as that of under-drainage, I beg to say that I much doubt if the drainage should be blamed for even a part of the evil in this case; for, to my view, the unusual clearance of timber should be saddled with the whole of the bad consequences. The most extensive drainage will do no harm anywhere, where there is, as there ought to be, for other purposes besides this, a proper distribution of trees. In order to realize the full benefits of extensive drainage it is necessary that the country, or district of country where it is carried on, should be protected by a requisite extent of wooded surface.

How important then to the success of farming alone is the subject which we are now discussing. Indeed it may be said that arboriculture must *precede* ere agriculture can *succeed*.

But I pass to another aspect of the question.

Narrow as Britain is, its climate is materially influenced by local causes. Why is it that there is a great local diversity in the quantity of rainfall in places whose general similarity of situation, as regards wind-exposure and surface configuration, would seem to preclude any material difference on an average of years? We find there is something distinct from mere local situation which determines this element of climate; and we have evidence, often painful evidence, indeed, that the cause lies solely in the character and nature of the surface of the district, in respect particularly to the area of surface occupied by trees.

It is of course obvious that the division of a country by mountainous ranges constitutes an individual local climate with respect to heat, moisture, and frequency of winds and storms; yet one of the ruling causes even in such instances is vegetation.

If those southern counties of England now being damaged for want of water, had been drained before the timber clearance, no bad effects would have at the time occurred, and as soon as they are again replanted, the bad effects will, I doubt not, disappear.

It is sometimes said "give me a good soil and I will produce abundant crops," but this sole condition as to quality of soil is not enough, for a favourable climate is even more important than a rich soil. It is a fact that, as regards the primitive soil, there is no difference betwixt the slopes of the Himalayas where the deodar and the broad-leaved oak (Quercus latifolia) luxuriate, and a great part of Scotland, the soil in each case being principally from granite and mica-schist. The difference of climate must be the principal cause of the difference of crop in this case. The succession of pine to oak, or beech to pine, in indigenous forests, has no doubt depended more on changes of temperature than any other physical cause. It is quite clear that different localities require different quantities of rain, according to the nature of the exposure, altitude, and geological formation, and that the geographical distribution of rain cannot meet the requirements of all parts of a country. Hence the need of those modifying circumstances which man can

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command being brought into play; for while it is beyond his power to interfere with the periodicity of events, to modify them certainly is not.

I remark, also, that periodical storms, originating at a distance, are not the governors of one regular rainfall. Rainfall, as I have already remarked, is mostly regulated by local influences. This is exemplified in the results brought out by Mr Symons. As regards our southern counties, the great clearing of timber, aggravated by drainage operations, caused such a local deficiency as was felt a long way northwards, while the belt of copious rainfall from the centre of Ireland to Edinburgh, possessing well wooded districts and being little interfered with by man, shews an exactly opposite effect. In either of these cases, had the rain come from a distance, its distribution would have been more general and equal.

And now mark what follows. Mr Symons acknowledges that rainfall records evince a regularity not before expected. Even local irregularities, large as they are, are neutralized by the combination of the whole. In short, his valuable paper goes to shew that for the last fifty years the amount of rainfall has, taking one year with another, been nearly identical with the mean.

I repeat, that the observations of half a century make it clear that the rainfall of these isles is, for all practical and general purposes, a regular one; that great extremes, which are rare, may be due mostly to causes outside ourselves, and that ordinary irregularities are governed by causes within ourselves. It is with these irregularities that the scientific arboriculturist has to deal.

The relative proportions of woodland formerly given do not apply as a whole, not being properly distributed. We want a more regular distribution, and until this is done, it is perfectly plain we will never secure adaptable climates; and until we employ the means in our power to bring about as much regularity or steadiness, in our climate as possible, it will be difficult, if not impossible to make meteorology practically useful.

It would be curious and instructive to trace out in detail the changes which would result from a more equable temperature—the result of our attentions to Arboriculture as a science. In reference to trees themselves, the present varieties of quality in the same species, even in this country, is due in a great measure to a genial or ungenial summer, and the evidence of this is strikingly shewn in their concentric growths. Vegetable life differs in no respect from animal in its limit of duration as influenced by favourable or unfavourable circumstances—in having an even flow on the one hand, or sudden extremes of heat and cold on the other. Just as a man will live a less healthy and a shorter life who courts extremes of climate, or other habits, so will a plant p re-mature and this being the case, we know that an unequally growthed tree is not so durable in quality and does not produce the like quantity of timber as one does under more equable and temperate circumstances.

A tyro in botany can explain why a rapidly-grown tree is stronger than one of slow growth; but while the one gives strength the other gives durability, and our aim should be their combination.

But I think it may be safely said, that we are now in possession of sufficient material from which clear and precise inferences may be deduced. I come to this conclusion, from perusing the voluminous records of careful observations over the whole land, and am arrested by this plain and pointed question:—With the knowledge of these two facts, the general *regularity* of rainfall, and that *local irregularities* are governed mainly by *local influences*, are we still to carry on the same plan of observing, recording, and deducing? Is it not time to amend our course of procedure in relation to atmospheric science? We are in possession of such soundings as will enable us to steer with some measure of safety, but what the further course of the voyage should be exactly, I am not at present prepared to say. Its object, in the first place, should probably be to establish a set of direct experiments to test the deductions which we have drawn from the general ones. The question which I wish to set before arbori-

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culturists and meteorologists is this:—At certain geographical positions, exposures, altitudes, and on certain geological formations, with and without artificial drainage, to what extent and in what way do trees, and other vegetation, exert their influences? Properly conducted experiments, bearing on these and like points, would doubtless lead to important results, and would at once lay the foundation for a new era in the history of our rural economy.

So far as I know, the only paper bearing directly on this subject was by the committee appointed by the British Association in 1851, to consider "The probable effects, in an economical and physical point of view, of the destruction of tropical forests." They admit that there is a deficiency of exact or experimental information on the subject, that is, on the physical effects of the removal of forests, and that "observations of a precise character on climate in countries once covered by forests, but now cleared, do not exist." Indeed, the whole question given them was a probable one. The report of this committee (ably superintended by Dr Cleghorn, India), contains, however, several very valuable remarks, and, at the same time, some questionable ones. For example, on the question between the maintenance and removal of forests, they say that "whenever the progress of population requires that every portion of the soil be made to yield its quota of human food, there the destruction of forests is to be desired." Now, it being admitted that tree influences are immediately local, I much question if even a sort of isolated planting would do—such as on distant hillsides, leaving the lower lying and more valuable lands clear of wood.

In a letter from Dr Wight to Dr Cleghorn, 1851, it is well observed:—"As to the destruction of forests it appears to me that there can be but one opinion on the subject, and that is, that it is most injurious to the welfare of any country, and ought upon no account to be tolerated, except where the ground they occupied can be turned to better account, and even then entire denudation should be avoided."

The author of that interesting work "Sunshine and Showers," sums up a chapter on "the influence of trees on climate" thus:—"It is a question demanding immediate inquiry, in order that the truth of the matter may be known before the owners of estates shall have permanently injured their own interests, the general interests of the island and its population, before Government shall have lost any opportunity of interference." He also says that a vast deal has been said and written on the influence of trees, without elucidating the subject by reasoning founded on clear and precise experience; and, therefore, we must be thankful to any one who can furnish us with such downright facts as may enable us to draw our own conclusions. Let the Scottish Arboricultural Society take this hint, and set to work at once.

Now-a-days, if a party creates what is called a nuisance—affecting the health of others or that of his crops, the law provides a remedy, but in this more important matter, where a quarter of a century or more must elapse before an over-clearance of wood can be remedied, no immediate action can be taken. Let us take warning from the dear-bought experience of other nations. But it is not only an individual nation's interest. The undue clearing, or preservation, of the forests of one country concerns that of another, as, being directly connected with the production of rain, any disturbance in the one must affect the other. Climate concerns the whole community, and its prohibition from injury is one of the duties of Government. There are especial laws in France and Germany against the overclearing of forests, and compulsory directions as to replanting. Why, then, the indifference in this country?

We are asked by some if we cannot "take a hint from *nature*, and make amends for having interfered with her provisions. We are told to plant *oaks* on the hill tops, and every locality unfit for other cultivation." This advice will not do, I fear. I would take a hint from nature, but not fall back upon her methods altogether, for is she not the parent

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of marshes, bogs, and in many cases of extremes of temperature and of noxious gaseous admixtures, which produce fevers and other diseases? We must respect mother nature, but may not follow her in all things.

Plant *oaks* on the hill tops! where, in the majority of cases, neither soil nor climate is suitable. Any other locality *unfit* for other cultivation will not bear broad-leaved trees in the first instance. This proposed remedy for the future is a little hurried. When the day comes that oak will thrive on hill tops, and in any locality unfit for other cultivation, we may congratulate ourselves on arboricultural science and practice, or look for some extraordinary revolutions in the economy of nature.

I repeat that, upon the grounds of the foregoing facts, it is evident that a climate may be *made*, or at least regulated by man, to suit different crops and districts. As a certain body of trees do influence, one way or another, the climate of its neighbourhood, it really results that, by a proper distribution of variously sized plantations, man may come to suit, in degree, the climate to the plant, and not so much the plant to the climate, as he must do in present circumstances.

As illustrative of the effects of trees on the health of the population, I would refer to the districts of Grantown and Abernethy, in Strathspey, which, before 1856, were covered with some 15,000 acres of nearly continuously close masses of plantation and natural forest. After 1856, and to this date, a regular system of thinnings and clearings has taken place. The population of these districts in 1861 was 5871, and the extent embraced is some 90,000 acres, thus shewing one acre of wood to every six of other crops or waste land, being double the average of the kingdom.

The Registration Act not having come into operation previous to 1855, prevents the possibility of getting reliable information as to the per centage of deaths when the country lay under a close mass of wood; but as from that date to 1861 is sufficient to allow for any change of climate brought about by the thinning and clearing, we can ascertain in what way it has become perceptible. The following table shews the deaths for the four years ended 1865:—

Districts.	Population, 1861.	1862.		1863.		1864.		1865.	
		Deaths.	Per cent. to Population.	Deaths.	Per cent. to Population.	Deaths.	Per cent. to Population.	Deaths.	Per cent. to Population.
Grantown,	3943	77	1·95	73	1·85	66	1·67	63	1·34
Abernethy,	1928	39	2·02	38	1·97	28	1·45	18	0·95

We find, then, that the deaths have decreased gradually every year, from 77 to 63 in the one district, and from 39 to 18 in the other. In figures, the difference of ·85 per cent. over the whole may seem small, but it really represents 49 deaths a-year, which is a very large decrease in a rural population, and more especially as the bad influences of too much wood in Highland inland districts, such as these, must be counteracted by altitude and the surrounding mountains.

Of course it is almost impossible that a yearly decrease should continue; and, besides, it may be that previous to 1855 the deaths were some years as low, if not less, than any of those given. (Since writing these notes, I learn that the deaths in 1866 were 70, which is just the average of the four preceding years.) There are invariably fluctuations in all districts; but no epidemics having occurred, we are led, without doubt, I think, to attribute the great and gradual decrease of deaths in that part of Strathspey, mainly, if not altogether, to the wood surface having been brought down to a more healthy proportion.

A similar plan of improvement among the woods is in progress in Braemar, and it will be to me very interesting to note the effects.

There is little doubt that much of the suffering inflicted on mankind by what was attributed to the disorder of the seasons, must be accounted for by their own carelessness and improvidence, as in the case of an over-clearance or allowance of woods and forests.

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Some still say that Nature is the best forester in the sense of thinning or regulating the number of trees on the ground; but, neither in this, nor in the extent with which we are provided with them naturally, does it suit, as we have seen, to allow things to have their own way. Yet I am to take advantage of the fact of nature's bounty, and to say that the great importance of arboriculture is more manifest from the early care which she takes in covering the surface of the countries with trees.

It may be safely said that civilization cannot advance without trees, and that those must be the most civilized people who cultivate them on scientific principles.

Without its timber, Britain, and more especially other countries less favourably situated as regards latitude and sea influences, would, it may be safely said, never have attained its present eminence, either politically or agriculturally.

Purely practical men may say they want nothing more to guide them as to which trees are suitable to various soils, elevations, and exposures, and securing these, the results or effects produced on the crop must, as a natural consequence, be of the most satisfactory and of one kind, namely, healthiness; but while quite sufficient so far, it cannot subserve the purposes of science as to the health of the people, and other influences.

Practical forestry has made great strides during the last thirty years. It has been slow, but sure; and from this I would fain predict that so sure will be the ultimate success of arboriculture as a standing science in our country. I can well see, that to know a tree, in every sense of the word, will yet become the aspiration of every sound-thinking interested man. But to attain to this, and to bring arboriculture, as a science for every-day use, within the grasp of not only the practical woodman but the majority of landed proprietors, it is necessary that some system for guidance as to observations or other information, should be established by a body of scientific and practical men. It is no doubt a wide field, out of which much more may issue than the few indications I have sketched. Indeed, I have only introduced the subject.

There are various other aspects of the question equally interesting and important to those I have dealt with. Enough has, however, let me humbly hope, been said, to shew the immense importance of the subject.

I know of few things at the present day so deserving the attention of political economists as the present extent and distribution of wood over a country. It is plainly the duty of Government to take this question in hand, and it is, I think, equally evident that it is one of the duties of this Society to agitate for a scientific inquiry on the subject.

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IV.—*ON THE TRANSPLANTING OF FOREST TREES.*

BY CHRISTOPHER YOUNG MICHIE, FORESTER, CULLEN HOUSE.

NO branch of arboriculture more urgently demands our attention, study, and interest, than that of planting or transplanting forest trees, and it is only upon close observation of what takes place in nature, and by observing as far as we can the operations of her unerring laws, that we can reasonably expect success to attend our labours.

By nothing short of the most attentive observation, lengthened practice, and protracted experience, together with careful study and minute investigation as to the results of our own and others labours, are we enabled to acquire anything like a competent knowledge requisite for the prosecution of the art of planting. In order to attain to success in planting, we require the refined taste of the artist, the foresight of the philosopher, and the skill of the scientific, especially as relates to the laws of physiology. The writer does not presume to infer that he is fully acquainted with all the various conditions upon which successful planting or transplanting depends, yet he believes that his experience in the practice of that art will be found of sufficient merit and importance to be worth recording.

HARDWOOD TREES.

One curious circumstance connected with transplanting hardwood trees came under the writer's observation about twenty-eight years ago: a farmer having occasion to fix two gate posts at an entrance to one of his fields, thought proper to use two sycamore trees for the purpose. Experience having taught him that the heavier the posts were at the base the firmer would they remain in the ground, the trees, therefore, instead of being cut down in the usual way were grubbed round the base, cutting nearly close to the trunk all the principal roots. The trees were thus lifted with a club base, but without any small roots or fibres attached.

The trees after being felled, were cross-cut at about 7 feet from the ground, thus leaving that part intended for the gate-posts entirely void of branches, and almost equally so of roots.

Holes having been prepared, the posts were put into the ground, about a foot deeper than they stood when growing. The ground was firmly beaten around them, and the gate hung between them in the usual way. The work was performed about the month of March, and by midsummer the posts began to produce shoots near the top. Next season the shoots were prolonged, and the growth uniformly continued till about five years ago, when the bark of one of them began to decay at the surface of the ground, from which cause it soon withered; the other, which the writer saw lately, is still in a growing state, but the bark upon it also at the surface of the ground appears unhealthy, and the tree is not unlikely soon to fall a prey to the same disease. Speaking of the two trees as one, they would now be about seventy years old from the time of original planting. At 6 feet from the ground, they girth 40 inches, and are about 20 feet high, with spread of branches about an equal number of feet. Many trees in the plantation from which the above were taken are at present quite as small, though these are considerably below the average size, notwithstanding, at the time of removal, they were the largest. The difference of size is, doubtless, due to various causes, such as the mutilations they sustained at removal, and the undue depth at which they were put into the ground. The cause of premature death in the one, and that which is likely soon to cause the death of the other, is almost unquestionably the result of too deep planting.

In this and the surrounding neighbourhood a similar practice of hanging gates was carried

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on to a considerable extent, and, with very few exceptions, the trees thus treated all grew well; but, at the present time, what from accidents by cart-wheels injuring the bark, or that of too deep planting, scarcely one of them is now alive.

Though the above system cannot be recommended for removal or transplantation of large trees, seeing the top, wherein consists the beauty of the tree, is entirely cut off, yet enough is to be learned from the practice of reducing the top to such dimensions that it may be maintained in life through the vessels of the roots, that certain modifications of the practice may, with advantage, be carried out in practical operations of planting.

Another interesting instance occurred in another part of the country, in the following manner. In the course of erecting a farmsteading, an elm tree was found to stand in the way. From the size of the tree, and the advanced season of the year (the latter end of June) it was deemed inadvisable to attempt removing and transplanting it. Whilst the workmen were engaged digging up the tree with the view of carting it away, the proprietor, an intelligent nobleman, happened to pass at the time, and very courteously tendered his advice, by recommending to lop off a considerable portion of the top of the tree. This was accordingly done; and although the work was somewhat rudely performed by unpractised labourers, yet the success has been everything that could be desired. At the present time the tree is considerably larger than any of the same age in the plantation from whence it was removed. Why this tree should be of faster growth than the others is only to be accounted for from two circumstances, viz., the breaking up and rendering the earth loose and open around the roots in the act of transplanting, and that of the very moderate depth at which it was planted, being at least six inches above the general level of the ground. From these circumstances, the surface roots have been enabled to develop and expand to a wonderful extent.

Another instance clearly indicative of the importance of reducing the tops of trees in proportion to the roots by which they are sustained, came under the writer's observation five years ago. From fifty to sixty trees at one time had been left in a private but vacated nursery, and after remaining till they attained from 15 to 20 feet in height, were transplanted in the vicinity of a village, in order to produce immediate ornamental effect in the landscape. This took place about twenty-five years ago, and with apparent success. Owing to subsequent improvements in the place, it became necessary to lift and transplant the whole of the trees, which had now stood about twelve years in their situation. On their removal they were carefully dug round one year previous to lifting, their tops were also partially reduced, and the whole operations were conducted with skill and care, and resulted in the whole trees growing well.

Again, in about eight years, owing to the widening of a road near the village, it became once more necessary to lift the whole row of trees, and remove them backwards a distance of about 5 feet towards the field side. On this occasion the trees were lifted without any previous preparation by way of digging around their roots, and were planted without reducing their tops. The results are that, up to the present time, more than one-half of the trees have perished, and the remainder are sickly and not likely soon to overcome the effects of their removal.

Considering the advantages these trees enjoyed by having previously been removed several times, and consequently more than usually well-rooted, they would almost certainly have grown and flourished well but for want of the necessary skill in reducing their tops within due proportions.

Twelve years ago the writer conducted the lifting and transplanting of a fine English oak. The tree originally stood on the margin of a plantation, about 150 yards distant from the place to where it was transplanted. No preliminary preparation was made for transplanting it. The tree was dug round and carried to its new site the same day, upon hand spokes, bound with straw ropes to prevent them from injuring the bark. The tree was carefully lifted with a large ball of earth adhering to

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its roots, and planted with due care and attention. It was well clothed with branches, and proportionable in every respect. Its height was about 25 feet, girth of stem near the ground 2 feet, part of stem clear of branches 8 feet, age twenty-eight years, and was planted in the month of March in a very healthy state, and under generally favourable circumstances. No top pruning was performed, and the tree looked perfectly healthy, and grew well till about the beginning of July, when all of a sudden every leaf withered and shrivelled up, as if singed by lightning, which inexperienced persons assigned as the cause of its death.

Anxious to know, if possible, the true cause of this phenomenon, the writer set to work to examine the tree, and found that not only were leaves and branches dead, but the trunk was also quite dried up, shewing that the leaves were the last part of the tree to indicate absence of vitality. On cutting up the trunk piecemeal, to discover if any part was vital, he found it quite dry down to within 6 inches of the root. He cut over the stool to within 4 inches of the ground, rounded, and neatly dressed it, and in a short time shoots began to burst forth. One of these, to which preference was given (the others cut away), attained that season the height of fully 4 feet, but being subsequently found in the way of improvements was afterwards removed. The cause of failure in this instance evidently arose from the undue proportion of top compared with the roots which had to nourish it, the latter not having sufficient fibres to convey the necessary sap. Why the whole top and trunk of a tree should perish under such circumstances is difficult to account for, while by lopping off the top, either wholly or partially, the stem at least is preserved alive.

The writer is aware that the operation of top pruning is objected to on account of disfiguring the tree; the latter, however, is the result only when done by unskilful and unpractised hands, and has by no means a bad effect when carefully performed.

Last spring the writer had the opportunity of observing an elm tree planted in a conspicuous public place; the tree was only 14 feet high, but very proportionably and well grown. The work of planting was well performed, and at a good season of the year (the latter end of March). From the size of the tree, its state of growth, &c., success might have been anticipated, yet total failure was the result. After midsummer the tree gradually languished and ultimately died. The thought irresistibly suggested under such phenomena is, "What is the cause of death?" What the cause of the sudden change which the tree has undergone? The tree underwent no operation preparatory to transplanting, either by way of lightening the top or by cutting its roots, which, if done, would in all probability have preserved it alive. Thus it must appear that though the tree died for want of power to absorb moisture, this evil might have been prevented in different ways, such as by reducing the demand upon the roots, by diminishing the evaporating power of the leaves, by administering artificial substances as food, or by watering the roots and leaves.

A birch tree 40 feet high was lately transplanted. The tree was dug round and removed with a large ball of earth about 6 feet diameter, containing the greater part of the roots belonging to the tree; and no lopping or top pruning was in this case performed, nor the tree in any way prepared till the day on which it was lifted. The tree, on being dug round, had a large clear opening made to give free access to the workmen to undermine it, and to allow the implement, termed a janker, access to it for loading. The janker, as it is termed, is a machine of very powerful, but simple construction, consisting simply of two large strong wheels, and cranked axle, with a long pole attached to it, which acts as a magnificent and powerful lever. By increasing the diameter of the wheels, and with axle and pole proportionably large and strong, any ordinary sized tree may be expeditiously, efficiently, and economically removed; the only risk being that of shaking the earth off the roots. In the present instance, no severe shaking took place so as to

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disengage the earth attached, as the journey was only a few hundred yards across a smooth lawn. The tree, in being placed in its new position, was found to have its ball of earth quite perfect, and entirely interwoven with small roots and fibres. After transplantation, the tree was copiously watered, which induced the fine sandy loam closely and compactly to run in amongst and adhere to the roots, an almost insurmountable difficulty in transplanting amongst tenacious clays, and one of the chief causes of failure under such circumstances. Beyond copious regular waterings two or three times a week, and that of supporting the tree against the influences of the wind, nothing further was artificially done to secure its growth. The situation from which it was taken was considerably exposed, while that to which it was transplanted was well sheltered. The means to which success in this case may be ascribed were, the perfect state of the ball of earth, preservation of fibrous roots, due attention to keep the tree from undue agitation by the winds, and regular and copious watering whenever the state of the weather so required it.

An oak tree of large size, weighing several tons, was successfully transplanted in a nobleman's park some years ago. The tree was dug round in the usual way at the time of removal, and conveyed to its new situation upon a janker. On having to pass through several gateways, much inconvenience was experienced, as the gates and posts had to be removed in order to allow it to pass. The tree received due attention by copious watering, together with having some parts of the largest and longest top branches judiciously reduced. It was also well sustained against prevailing winds by moorings of wire. The tree originally stood in an open exposed situation, and upon a light loam, being well furnished with branches, and abundantly supplied with roots. The situation to which it was transplanted was considerably sheltered, and the soil moderately rich and open. The tree for sometime subsequent to removal appeared somewhat sickly, but soon regained its wonted vigour and health, and is now in a thriving condition. The forester who conducted the work connected with the transplantation was a man of great experience, and knew well the circumstances under which forest trees grow or decay, according to the depth at which the roots are placed in the soil; and in accordance with this knowledge he planted the tree in an elevated position by artificially raising the ground where it was planted. To this and to the former circumstances is probably due the healthy and vigorous state of the tree at the present time. No doubt the large ball of earth adhering to it, numerous fibrous roots attached, suitable soil, reducing of its top branches, and watering when required, all contributed in accomplishing the favourable state of growth. Encouraged by the circumstance of observing that trees not only grow, but flourish, under conditions apparently the most unfavourable, when their tops are cut off or greatly reduced, while under similar circumstances they perish with their tops remaining uncut, the writer resolved to make a fair trial upon the branches of a tree generally allowed, of all others of the hard-wood class, to be most difficult to transplant when of large size. In the spring of 1857 an opportunity occurred for making the experiment at P——d. The proprietor desired a hedge to be planted at once, fence high, and intrusted the work to the superintendence of the writer, who procured, from a plantation close by, beech trees to the number required. The trees were grown as a sort of underwood amongst larch—the latter being rather thin upon the ground; the former stood openly amongst them, but were by no means handsome trees, being deficient of side branches, and, having been originally planted at the same time as the larch, were consequently nearly of the same age; but while the larches were from 40 to 50 feet high, some even exceeding the latter height, the beeches were generally from 10 to 20 feet, except a few on the margin of the plantation, which were further advanced. On digging up the beech trees little or no earth adhered to them, and the fibrous roots were few in number, and, on being carted to the place of transplanting, the little earth

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that originally adhered was entirely shaken off. A trench 4 feet wide and about 2 feet deep was prepared along the line of the intended hedge, in which trench the trees were planted about a foot apart, and in the usual way of hedge-planting. On preparing the bed for the reception of the plants, a quantity of partially decayed leaves and road scrapings were collected, mixed together, and put into the trench to the depth of about 18 inches. After the trees were inserted, the roots were covered with the same mixture to a depth of about 6 inches. This being done, and well watered, the trench was filled in to a little above the level of the natural ground. The usual subsidence being calculated upon to form a receptacle for water in case of its being subsequently required in an artificial form. The work of planting having been completed, a hand-saw and hedge-bill were employed in cutting over the plants at about 4 feet high, leaving them in a neat smooth condition, at once a fence and ornamental screen. When last I saw the hedge it was in a very growing condition, very few of the plants having perished or gone back; and, on recent inquiry respecting it, the writer was informed that it continues in the same flourishing state.

At the time of planting this hedge some trees were planted out for ornamental purposes, and were treated in a way similar to the hedge as respects soil, leaf compost, &c., except reducing their tops. The results in the latter case were that only about ten per cent. lived, and those died down to near the surface of the ground, thus shewing the important effects of top pruning. Having fully satisfied himself of the various results and changes produced upon trees by cutting their roots and branches, and of the great amount of power in the hands of the planter to produce whatsoever results he pleases, his next inquiry was, how far soil affects their growth, both in their newly planted state and subsequent growth.

About twenty years ago a cutting was made in order to level a country road, and certain embankments were thus formed in doing the work. Upon some of these embankments trees were planted which were lifted out of contiguous plantations for the purpose. On one of the embankments referred to, a number of oaks were planted, from 10 to 12 feet high. These have now stood nearly twenty years in their present position, and the tallest of them is scarcely yet 14 feet high, while many of the others are actually shorter than when transplanted. These trees were lifted out of a cold clay soil and transplanted into one of a similar nature. The only circumstance calculated to favour their growth in their present position over that from whence they were removed was the open and pulverised soil of the embankment and dry position upon the sloping banks. These favouring circumstances, however, seem fully counteracted by the extreme exposure and infertility of the soil.

Having witnessed the unfavourable results upon trees removed from cold clay soils such as that referred to, and transplanted into soil of similar qualities, he was further anxious to witness certain results under different circumstances, such as the removal of trees from a warm dry soil to a cold and damp one, and also of seeing the effects produced by removal from a cold unfavourable soil to that of an opposite extreme.

A small proprietor had a number of oaks and other trees taken from a large plantation, about twenty years old. The soil of this plantation was a strong red clay, and the trees when taken up had scarcely any earth balls attached to them. Being for ornamental planting, the trees were selected with all due regard to their form and proportions, and were very carefully taken up, so as to inflict as little injury as possible on the roots. The trees were carted to their new destination, a distance of several miles, large pits were dug for their reception, and every possible care bestowed in planting them. The soil into which they were planted was loam of various qualities, the most inferior parts of it far surpassing that of the plantation from which the trees were taken. The results have been that scarcely any of the trees are yet taller than when removed about fifteen years ago. They are, however, in some cases, making

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considerable growth latterly, but are at most but large spreading bushes.

It was found lately on examining the roots of the trees that the original ones had completely decayed, and a new class of fresh ones had originated from the lower part of the stem. About one-third of the original number of trees planted perished during the first five years after removal.

During the month of February 1850, a row of trees was planted upon the side of the highway between J. and D. The trees were lifted out of the adjoining plantations, which were about twenty years planted. The soil in the plantations was generally loam, rather light, and the trees on being lifted had their roots greatly bruised and mutilated. The soil to which they were transplanted was a tenacious clay. The trees, while badly rooted up, were equally destitute of side branches, having much the appearance, about a year after planting, of maypoles or rural fishing rods. The side branches, though few in number when the trees were transplanted, had still further diminished, till almost entirely destitute of them. Not only were the branches dead, but the bark had also become detached from them, and hung in unsightly shreds waving in the wind; while the branches themselves appeared white as ivory from being washed and weather beaten. Indeed, at that stage, nothing more unsightly could possibly be seen, and few proprietors could have resisted the temptation of cutting them down. The line of trees contains altogether 105, being now ten fewer than the number originally planted. The cause of those ten trees perishing was consequent on animals rubbing against them, as they were not at any time protected against such injuries. In the row the trees stood 30 feet apart, and 2 feet out from the hedge towards the fields. The species of trees comprise sycamore, lime, elm, beech, aspen, and balsam poplars; the greater number, however, are sycamore. The writer, having frequent occasion to pass along the highway, took particular interest in watching the progress of this strange unpromising row of trees. During the first five years after planting they made no perceptible progress, but in several instances became actually smaller than before planting. The first signs of vitality were the putting forth a few small shoots at the junction of the old branches with the stem. During several winters subsequently the number of dead branches upon them made them still appear as if quite lifeless. During the next five years, and up to the present time, the progress of growth has been quite marvellous: not only are the stems shooting up in the centre of the trees, rapidly assuming the character of timber, but the branches are growing equally well horizontally, altogether forming, if not magnificent tops, at least handsome and beautiful trees, well formed, and proportionably grown. The trees generally have from 6 to 8 feet of stem clear of branches, owing in some measure to sheep and cattle browsing upon the lower branches. General height of the trees from 15 to 20 feet, girth of stem near the ground a corresponding number of inches, which is a good proportion. In this case nature unaided and unassisted was about ten years in accomplishing that which by the aid of art she would have done in five years. One remarkable circumstance in this case was the small number of trees that actually perished.

The solution of the problem appears to be this, the trees were so far deficient in branches as to give the roots the vantage power over them. The branches upon a tree are arranged and disposed very much as the roots are. In this case, however, in consequence of the trees previous to transplanting having grown up closely together amongst others, they thus underwent a natural process of pruning, which, to a considerable extent, explains the obscure circumstance.

In 1858 the writer planted a considerable number of trees of various sizes and sorts for ornamental purposes, comprising chiefly oak, lime, sycamore, and horse-chestnut. The district was well furnished with pine plantations, but few hard woods of any sort were to be seen. Much of the arable land of the district though in a high state of cultivation is nevertheless naturally poor. The subsoil, too, is uncongenial

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to most sorts of hardwood trees. An effort was made to clothe the barren and bare roadsides by introducing hardwoods, which form a pleasing contrast to the dull pine plantations and square fields around. Two difficulties in the outset stood in the way, neither of which was easy to surmount. The one was a want of the proper sort of trees at command. The other an unsuitable soil. Operations of planting, however, were commenced and carried out as best they could upon a somewhat extensive scale. The lime trees were originally grown in an advanced private nursery a few miles off, with a view of transplanting for immediate effect. The trees were thoroughly well rooted, having been, while in the nursery, several times lifted and transplanted for the purpose of improving their roots. The trees were from 10 to 12 feet high, well clothed with branches, altogether forming handsome trees, and likely to do well. In planting, the pits were duly prepared, soil was taken from the fields adjoining, and put into the pits to encourage the growth of the trees. After planting, supports were put to them to insure stability against the prevailing winds. At first, the trees bade fair to thrive, produced broad healthy leaves the first season, and in some cases several shoots; gradually, however, signs of sickness began to appear, the leaves by degrees became smaller, and early in the season assumed a rusty appearance, and became autumn-tinged long before the end of the season. At the end of autumn, many of them had perished down to within 2 feet of the surface of the ground; and when last the writer visited them, the whole, with only three exceptions, might be regarded as a complete failure. The exceptional trees were planted upon deep rich loam, mixed with road scrapings. From the general appearance of the whole trees the writer was led to believe, that the chief and only cause of failure was poverty and coldness of the soil. That the trees grew well at first, or at least appeared to do so, was consequent on the sprinkling of earth borrowed from the fields, and put around the roots, which, when once the roots had gone through, the trees languished and ultimately died. The manner in which the failure was produced may be further accounted for, from the circumstance that the trees, when in the nursery, were grown upon very rich loam, and in a sheltered situation, which circumstances combined, rendered the change sudden and perilous. What took place with the lime trees took place, also, with the oaks, though the latter were much more tenacious of life. The horse-chestnuts, though none of them are quite dead, are also in a languishing condition, but would apparently recover were it not for the injurious effects of the wind upon their leaves. The foliage of the horse-chestnut being large and soft in early summer, suffers much from exposure. Owing to the gummy nature of the buds, however, it is enabled to endure the severities of winter better than most other trees, which is so far in its favour. The sycamores are of all others doing best, and are likely to become handsome ornamental trees of moderate size. They were by no means so well prepared for transplanting as the limes and others were, having stood too much confined before removal in the nursery ground. The leaves, however, are large, and of a fresh healthy colour, such as usually indicates success. The sycamores were further submitted to worse treatment than the others were, by being planted in the most inferior soils. There is, from what may be seen in the above trees, no reasonable doubt that sycamore will grow and even flourish upon soils too poor for lime, oak, elm, and many others. One precaution, however, is necessary, viz., to avoid planting where its roots will reach stagnant water or tenacious clay. The locality from whence the trees were taken is situated at an altitude about 200 feet below that to which they were transplanted, and is also much exposed to north and east winds. The soil is a light sandy loam, varying, however, at places from a deep rich dark loam to a light sandy soil.

Altogether, it might have been predicted that the change to the trees must have been unfavourable in the extreme. The trees in this instance could not practically be watered, another circumstance doubtless fraught with

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certain injurious results, though to what extent is difficult to say. The annexed table will shew the cost, very nearly, of each tree respectively.

COST OF TRANSPLANTING.

Species of Trees.	Height of Trees.	Age of Tree since 2 ft. high.	Number of times removed in Nursery before transpl.	Distance of carriage for transpl.	Cost of pitting and planting.	Cost of Protection.	Value of Tree, carriage included.	Total cost of each Tree.
	ft.	years.	times.	miles.	s. d.	s. d.	s. d.	s. d.
Lime.....	12	10	5	6	1 0	1 4	6 0	8 4
Oak.....	8	5	1	6	0 9	1 4	2 0	2 9
H. Chestnut..	9	5	1	5	0 9	1 4	2 6	3 3
B. I. Poplar..	5	2	0	15	0 6	1 4	0 8	1 2
Sycamore.....	12	6	1	5	0 9	1 4	3 6	4 3
Spruce.....	3	1	1	5	0 3	1 4	0 9	1 0

Throughout the district other planting was performed about the same time as this was. In a corner of a field the writer planted a small group of trees, composed of oak 8 feet high, spruce 3 feet high, and black Italian poplar from 5 to 6 feet high. At the present time the oaks are only a few inches higher than when planted; the spruces are about twice the height they were when planted; while the black Italian poplars are from 15 to 20 feet in height, and proportionably thick of stem, and producing altogether a very imposing aspect, attained within a very few years. The soil is loose, dark, and damp, with a subsoil equally damp and stony. On observing the poplar flourishing and growing so well in so short a time; furnishing and beautifying a place recently tame and bare, and where other trees refuse to grow even moderately well, this case furnishes an encouraging example for others to imitate, who may wish to clothe and beautify a district quickly, and at moderate expense. This may be done, also, even in a park, or near a mansion, by planting amongst the poplars, at the same time, other trees of slower growth, but of greater duration, to remain after the poplars are cut down and removed.

During last spring, the writer lifted and transplanted above 200 large hardwood trees of various sorts. The trees were dug round for lifting during the previous winter and spring, and were transplanted in March and April following. At the same time that the trees were dug round preparatory to transplanting, their tops were all considerably reduced, which has a very beneficial effect in preventing the trees from blowing down with the wind, which they are very liable to do if at all top-heavy or exposed. Though compelled by circumstances to prune the tops of the trees in winter or spring, the fact must not be overlooked that August and September is a much preferable time of the year for doing the work. By pruning at the latter season there is no danger of weakening the tree by profuse bleeding, a result hurtful to all trees, but especially so to sycamore. The trees were mostly conveyed fully a mile to their new destination, the smallest of them in carts, placed in various positions to suit circumstances. Though the most favourable position to cart them in is an upright one, but want of head-room, from trees overhanging the roadways, and other obstructions, they had frequently to be placed horizontally. The largest of the trees were conveyed upon a janker, which was specially fitted up for the purpose. Only one tree was conveyed upon it at a time, and one or two horses drawing it, according as required. The difficulties to contend with in removing trees upon a janker are the infliction of injuries by bruising and displacing the bark. and also disengaging the earth from the roots. Where the ball of earth was large, it was necessary to place a strong low carriage underneath it, with wheels about a foot diameter. This prevents the earth from shaking off, and the roots from injury. The end of the pole of the janker upon which the root and trunk of the tree rests being bound

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with iron, is apt to gall the bark; hence it requires careful stuffing with mats, or other soft substances, which entirely prevents the injury from occurring. The results of the whole planting, notwithstanding the excessively dry season, have been most satisfactory and successful. Only about seven per cent. of the trees planted have perished, and these were chiefly beech and Turkey oak. The latter, in the writer's experience, is by far the most difficult of all forest trees to transplant.

Notwithstanding the amount of labour and expense attending this system of planting, it is probably the cheapest way of raising hedgerow trees, of beautifying the landscape, or affording shelter to stock, and will be found to bear a favourable comparison, in point of expense, with that of growing trees in any other way. The losses that attend the transplantation of large trees very little, if at all, exceeds that of planting small ones.

The writer is so fully persuaded of the advantages, pecuniary and otherwise, arising from transplanting trees from 15 to 25 feet over that of planting small ones, that in thinning hardwood plantations he never cuts down trees that are suitable for transplanting. Upon all such trees he puts a special mark, known to the woodmen, who leave them at the time of thinning, and afterwards, when convenient, they are dug round and top-pruned, and are thus ready when required for transplanting out.

After planting large trees, it is imperative to support them in some way or other against the prevailing winds. This is done in various ways, sometimes by means of stakes and bars of paling; sometimes by mooring them with strand and cable wire, and posts driven in the ground at proper distances from the trees; sometimes they are efficiently supported by laying a few large stones around the base upon the roots. In the writer's experience, it is always necessary to adopt some means of support. His preferred system of planting renders this imperative, as he always places the tree in the ground with the roots in an elevated position, somewhat above the ordinary level of the ground, so as to encourage them to run upon the surface, a circumstance possessing many special advantages. The practice of deep planting is one of the most hurtful that can be adopted, and is always sooner or later followed by baneful results. Considerable difficulty is often experienced in watering trees, to induce the water to penetrate the surface, which becomes caked and hardened after repeated waterings. To facilitate the absorption of the water it is often advisable to perforate the surface of the ground with a sharp iron instrument or foot-pick; as this practice, however, is often attended with results injurious to the roots by cutting and bruising them, it is safer and, in some other respects, better to insert pipe tiles in the ground, the upper end level with surface. The water when poured into tiles, soon finds its way to the extremity of the roots. Of all others, the most economic and efficient method of watering appears to be to leave the surface of the ground, at a short distance from the tree, in a depressed or concave form. The water thus rests in the cavity till it sinks down upon the extremities of the roots. It is sometimes asked, what is considered a fair and sufficient watering when the ground is considerably dry? One gallon of water to a cubic foot of earth may be considered a fair allowance—*e. g.*, if the roots are 2 feet deep for every square foot of surface of ground over which they extend, 2 gallons of water are required.

In selecting hardwood trees for transplanting, such only should be taken as have a perfectly healthy appearance. In healthy trees, the juices circulate freely, and possess inherent powers of healing, which is of vital importance in case of injuries having been inflicted on the roots, trunk, or branches. A thick fleshy bark, broad leaf, and rich colour, are all important indises and worthy of reliance in selecting trees.

In December last, the writer planted a number of hardwood trees from 10 to 15 feet high, which remained without supports for some time subsequent to planting. The weather was boisterous at the time and the wind shook the trees severely, producing around them, by friction, a hole in the earth

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that admitted water which afterwards became frozen, and the hardened surface of the hole proved very injurious by rubbing the bark at the necks of the trees. In a short time, if attention had not been paid to the circumstance, the trees would have been completely destroyed; as it was, they received considerable injury from which a salutary and precautionary lesson may be learned.

In 1853 the writer assisted in transplanting a group of trees around a newly-built cottage. The group consisted of oak, spruce, and Scots pine, together with some shrubs. The soil was a deep sandy loam, resting upon white sand and clay, at a depth of about 3 feet. The trees were grown in a reserve nursery about a mile distant from the place, and were conveyed thither in carts. Most of the trees were lifted with balls of earth attached, and were from 6 to 8 feet high. It was observable, from the time of planting, how well some of the trees grew, making large annual shoots, while others enjoying the same advantages, made no perceptible progress. The circumstance was so peculiar as to call forth special attention and examination of the roots of the trees, and it was found on exposing the roots, that those trees which were progressing favourably had been planted with balls of earth, while those of stinted growth had, through accident, lost their balls entirely, which explained and accounted for the discrepancy of growth. Those trees transplanted with the ball of earth attached continued to grow in their new situation as if they had never been removed or disturbed at all; the others, on the contrary, found it hard to produce a fresh class of roots, adapted to their new sphere of life. From the above and similar circumstances, the writer is persuaded that oaks or other trees planted from clay soils are very uncertain of success, and would therefore seek to guard against such consequences in transplanting.

In an advanced nursery known to the writer, a number of oaks stood, whose slow growth attracted his attention, and, anxious to know the cause, had some of them dug up, when he found that at last removal the roots had been considerably cut. The soil of the nursery is a somewhat retentive clay, and such as oaks, at first, do not succeed in. From this it must appear very essential to the welfare of trees, but especially to oaks, that no mutilation of the roots should take place, or be in any way unduly shortened or deprived of their fibres.

From the above and other instances which the writer could adduce, it appears that oaks, if transplanted from a clay soil without balls of earth attached, are very uncertain of success. Even small oaks, unless specially attended to in the nursery, by way of encouraging fibrous roots, are in all cases precarious to transplant.

CONIFERÆ.

Owing to the naturally constitutional difference between coniferæ and hardwood trees generally, it becomes necessary to treat them differently, each according to the laws which regulate their health.

The writer has found greater difficulty in successfully transplanting pine trees than hardwoods; this difficulty arising chiefly from the treacherous nature of the juices. A slight accident disarranges their sap vessels, the resin of the tree crystallizes and obstructs the canals, and sooner or later causes the life-spring to cease. Last spring the writer transplanted a number of pines and firs, which had stood several years in a shrubbery. They had numerous roots, but on lifting them, owing to the loose nature of the soil, the clay all dropped off, leaving them quite bare. Some of them were pruned by shortening their side branches, but none of their tops were interfered with; this was done by way of making an experiment to see if the effects were favourable, as in the case of hardwoods. In consequence of the severe drought of the summer they were all alike duly watered, but for which they would probably all have perished. About one-half of those trees that were pruned died in the course of the season; while only about one-third of those that were not pruned died. The above trees were planted upon a considerable incline, and upon sandy

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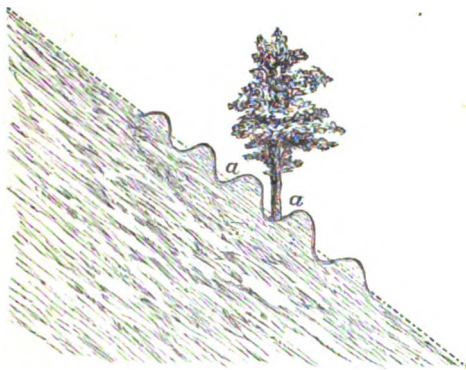
and gravelly soil, and owing to the incline of the ground, watering efficiently was very difficult to perform, in consequence of its running off before it had time to sink into the soil. To prevent this, the surface of the ground was left concave a little above and a little below the stem of the tree, as shewn in the annexed figure,—*a a* are cavities for the water which



gradually sinks down upon the extremities of the roots. When once the tree is fairly established beyond the requirement of artificial watering, the ground may be levelled up and turfed over. In the writer's opinion the excessive drought of summer, entire want of ball of earth at root, together with the hard gravelly nature of the soil in which they were transplanted, had a much greater influence in causing the death of the trees alluded to than the pruning. The unlevel surface of the ground thus produced is objected to on account of its unsightly appearance; but when the trees are fairly established beyond the requirement of artificial watering, the depressions of the ground are filled up, and the whole rendered smooth and level. Pruning in the above instance undoubtedly proved injurious, and other circumstances could be adduced corroborative of such results; but how far cutting off the tops of pine trees of larger growth might affect them is difficult to say. One circumstance may be quoted as worthy of notice. In several pine plantations known to the writer, the trees had their tops broken off from the effects of squirrels peeling the bark. The tops thus broken off generally left a portion of live branches upon the trunk, which branches not only survived, but increased in vigour. The writer has seen even one small branch upon a Scotch pine sufficient to keep the trunk alive, growing, and healthy.

In 1858 the writer had a number of spruces lifted and transplanted which were dug round preparatory to transplanting the year before. They were from 6 to 9 feet high when lifted, and were in a very rapid state of growth, making annually top shoots from 18 to 24 inches. On examination of the trees five years afterwards, the writer was considerably disappointed at their condition. Though all alive, not one of them was growing fast, the greater number making top shoots only from 5 to 8 inches, while the foliage was poor and of a light colour. The only assignable cause for the falling off of growth may be ascribed to having grown originally in a soft spongy soil approaching to moss, and their roots, being formed suitable for that situation were not at all adapted to their new one, they having, as it were, acquired a sort of aquatic habit; and having now no further means of sustaining themselves, relapsed into their present languishing state.

From the above, and other instances that might be cited, it appears absolutely necessary that due regard should be paid to the food a plant is originally accustomed to, so that in transplanting it to a new situation a similar provision shall be made for it. Allowance also should be made for any adverse change or influence that may be brought to bear against the plant. It should, for a time at least, have better food than previously accustomed to, to make up for the other means of support so unfavourably altered.

Larch trees of large size are difficult successfully to transplant, especially those of rapid growth. In making selection, where choice can be made, preference should be given to those of slow growth, provided only they be sound and healthy. In transplanting larch, it should be done only a few days before the bud begins to break, and the soil should be dry, pure, light, and open; they should also be lifted with balls of earth, as without such provision, failure is all but certain. In dry weather, and especially in autumn

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they should be regularly and duly watered for at least three seasons subsequent to transplanting.

In the vicinity of Edinburgh, a few years ago, the writer had his attention directed to a portion of a nursery planted with Cedrus deodara. The plants were from 4 to 8 feet high, and transplanted early in the spring. About one-half of the plants presented a very favourable appearance, the others quite the reverse. The ground was all much alike, the plants all of the same stock, and the work of planting done at the same time. The cause of failure in the one case was explained as caused by the earth ball being broken and the earth shaken from the roots of the plants, which was done intentionally, and with the view of encouraging root growth. Those which succeeded, and without any deaths occurring, were lifted carefully, and planted with the earth adhering. No better or stronger proof than this can be adduced to shew the importance of preserving the earth about the roots of such plants in the act of removing them.

In 1857 the writer transplanted large coniferæ rather extensively and successfully by adopting the following method: Where the plants were found to have earth balls adhering to them, they were simply transplanted without other auxiliary, but in all cases where the earth fell off the roots in performing the work, he planted them in leaves, at same time administering water freely. During the same season, in the month of June, it became necessary to remove several pines and large shrubs. In performing the work, the earth was entirely disengaged from their roots. They were, however, all planted in leaves as above, and none of them died. During the past summer the writer had occasion, in the month of July, to lift 60 silver firs, from 10 to 15 feet high. These he planted in a heap of leaves; and without any other attention they all struck root and grew, except two of them, which had their roots severely mutilated. The success that attended the preservation of these trees was all the more wonderful, considering that they were removed without almost any earth adhering to them, and at a time and season so remarkable for its excessive heat and drought that thousands of plants which had long been established in the ground withered and died. Even some of the silver firs referred to were at the time of removal suffering considerably from the effects of the drought, but on removal have recovered, and are at present growing and healthy.

Another circumstance connected with planting in leaves is worthy of notice. In a reserve nursery, a number of trees, from 6 to 8 feet high, were lifted for the purpose of transplanting, but, being overgrown, the best only were selected and the others cast away, being carelessly thrown over the fence as useless. A quantity of leaves accumulated about the roots of the plants thrown away, which induced them to strike root, and they were found afterwards in a better state of health, making more rapid growths than those which were carefully taken up and planted with skill and attention. This is another proof of the power and virtue which leaves possess of encouraging and producing root growth, their chief virtue probably consisting in the moisture they retain and food they afford to the roots of the plants.

Various means are adopted to impart stability to trees newly transplanted. As such are frequently objects of fancy and taste, it is desirable that the means adopted for the purpose should also be such as will please the taste and fancy of those having pleasure in them. However well a tree may be planted and look, its beauty is greatly marred if surrounded by an inappropriate object. As the means of supporting trees are so great and varied, it would be out of place here to attempt to describe them; hence, a passing notice is all that can be afforded. For large trees moorings are often constructed of strand wire, and posts driven into the ground, as a very efficient protection. For smaller trees, posts and rails may be used in various ways, according to taste and circumstances. Stones are also made use of, by laying them around the base of the tree; and were it not for their objectionable appear-

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ance, they are probably of all others the best protectors.

GENERAL CONCLUSIONS.

Having already extended the subject of transplanting beyond the prescribed limit, the writer will briefly conclude by offering the following supplementary remarks. First, in selecting hardwood trees for transplanting, it is desirable to take them from a higher to a lower altitude, from a poorer to a richer soil, from loam to clay, from an open to a stiff, from a cold soil to a warmer one, and from exposure to shelter. These conditions apply more to the future success than to the immediate growth of the plants. That the form and habit of the tree should be duly observed in making selection, choice should be had of such only as are of free but not luxuriant growth, having a clear fleshy bark, full and well-developed buds. Of the gummy sorts of trees, those should be preferred that are most gummy, and those of resinous buds whose buds are most resinous. It is better to select those trees which have numerous small branches, with stem thick at the base, and gradually tapering towards the top, with branches diverging from the tree horizontally, rejecting those whose branches are vertically inclined. In selecting pines for transplanting, choice should be made of such as are of very slow growth, stems straight, and uniformly tapering from base to top, and clothed with rather slender branches, clean healthy bark, rich, and generally dark foliage. In other respects the same conditions are applicable as for hardwoods. As the larch differs so widely in its growth from both hardwoods and pines, it requires different treatment. Wherein it differs most widely is in its impatience of confinement, both in respect to roots and branches. How far the larch will submit to pruning, so that when transplanted the balance of growth may be so maintained that the roots may be able to sustain the tree, is, to the writer, a matter still of uncertainty. That cutting off lateral branches, and even cutting over the stem to within a few inches of the ground, is attended with no injurious results, but often the reverse, the writer can testify; and in corroboration of this statement it is only necessary to look into a young larch plantation, where hares have eaten over part of the larches. Those trees so eaten not only survive while others die, but in two or three years, if not eaten a second time, are stronger and further advanced than those not eaten. In preparing trees for transplanting, a trench should be dug around them, describing a circle somewhat within that of the outer branches of the tree. The trench should be made sufficiently deep to cut all the roots, and then filled in with earth, fresh and richer, if possible, than that dug out. After being dug round, the tree should be allowed to remain one, two, or three years, according to circumstances, when it will be fit for removal; but if not removed at the end of three years, a second digging will be found necessary, and should be done in such a way as to keep clear of the last-formed trench, or inner edge of the former trench, and avoid taking off the new-formed fibres. When the circle described around the roots is necessarily too small compared with the spread of the branches, the latter should be reduced in due proportion, otherwise the roots will be unable to nourish the whole tree. Digging round and preparing of the roots, should be done in spring, while pruning the top should be performed in autumn, at least one year previous to transplanting. In consequence of the unavoidable disengagement of earth from the roots of the trees in the process of transplanting, a necessity is thus induced of artificially aiding them in obtaining sufficient nourishment in their new situation; and as the food of trees is only absorbed in a soluble state, this must be done by duly watering them. Moist leaves, with a sprinkling of sand amongst them, are probably the best ingredients as food to apply to a newly-transplanted tree. When it is found necessary to form depressions in the ground for the purpose of watering the plants, it should be done about half distance between the stem of the tree and the extremities of its roots. In preparing the pits for receiving the trees, they should be made one-third larger than the ball of the roots which is to fill them. The subsoil also should be loosened for a considerable depth; and when stagnant

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water occurs in the bottom, a stone or tile drain should be introduced to carry it off. September and October are the best months of the year for transplanting trees generally, but April and May have certain advantages for transplanting evergreens, though not so great as September. The expediency of reversing the position of trees in their new situation, such as placing the seaward side landward, or *vice versa*, is a questionable practice. The benefits arising from it are more than counteracted by the injurious results, which results would require a somewhat lengthened physiological explanation, which want of space precludes. The art of transplanting is now much less obscure and mysterious than in former days, yet much has to be learned in order to obtain definite results and success. In the act of transplanting where watering is required, it is better to pulverize the earth, and fill the pit with it while dry and loose, and afterwards thoroughly saturate it with water, which is better than by beating or tramping the earth. In substituting fresh earth for that taken out of the trench, in order to introduce that which is most adhesive for removal, it should be composed of turf mould taken from a clay soil, and well mixed with leaves or other fibrous substances which adhere to the roots.

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V.—*ON THE PRUNING OF FOREST TREES.*

BY CHRISTOPHER YOUNG MICHIE, FORESTER, CULLEN HOUSE.

AS numerous and conflicting opinions are entertained in regard to the practice and art of pruning forest trees, it may be advisable, before entering upon details of the subject, to consider the practice as it at present generally prevails. Much light has of late years been thrown upon this hitherto somewhat mysterious and obscure art. Science has done much to dispel the haze which surrounded it, standing, as she does, with eyes ever open to observe and detect the various operations of nature, and lend a helping hand. To those who follow the light of true science, the art of pruning is clear and comprehensible; while to those who are drawn aside by every flickering taper, whether lighted only to-day or twinkling for ages, the art is obscure, and the views respecting it are as varied as the sources are from whence they are derived.

Some persons practise and recommend a system of regularly and uniformly shortening all side branches upon the tree to within a few inches of the trunk. This they assert is highly favourable to the healthy development of the tree, by producing spray and healthy foliage. Another class can see no utility in the practice at all, beyond merely clearing the trunk of the tree to about half its entire height of all lateral branches, allowing it in all other respects to remain as it happens to grow. Again, a third class practise a system somewhat allied to pollarding, as practised in woods grown exclusively for fuel. This is done by cutting off all the branches close to the trunk, leaving only a tuft of branches shortened in slightly on the top. The object of this, they say, is to enable a greater number of trees to be grown upon a smaller space, and at the same time to preserve a tall clean trunk. There is yet a fourth class, which includes by far the largest number of those who practise pruning at all, and may be considered to comprise those who are advanced in the art, or who practise it upon what is called the true system, in the same sense as we speak of the high system of farming. This class, though in advance of those previously mentioned, must still be considered as yet far behind in thorough scientific knowledge of the art, but who, it is trusted, will find all their objections fairly met, and their difficulties overcome in the sequel of this paper; for though we may be considered in error in the general practice of pruning, they may yet be led to a better and more advanced acquaintance with their profession.

A thorough knowledge of vegetable physiology, and of the laws generally that regulate the health of plants, is as essential to the man who practises pruning, as a knowledge of anatomy is to the surgeon who amputates a limb from the human body. No particular, rigid law can well be laid down for pruning, so as to be applicable to every case with unerring certainty and success; therefore the only true way to arrive at perfection in the art is to examine thoroughly into the true nature of the laws and principles that regulate the healthy development of plants in all cases, conditions, and circumstances. In the words of Professor Lindley—"The object of the pruner is to diminish the number of leaves and branches, whence it may at once be understood how delicate are the operations he has to practise, and how thorough a knowledge he ought to possess of all the laws which regulate the actions of the organs of vegetation. If well directed, pruning is one of the most useful, and if ill directed, it is one of the most mischievous operations that can take place in forests."

Again, the same author says—"Pruning may be regarded as a necessary evil to which the wise must submit because of the ignorant, the careful to cure the evils inflicted by the

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careless." The substance of the doctor's remarks would do well to be engraven upon every pruning-knife, and kept constantly before the eyes of the operator. We apprehend it will appear from the foregoing remarks that the principle, if not the only cause, of the difference of opinion that exists in regard to pruning, arises out of ignorance of the principles upon which it ought to be performed. We strongly recommend those who doubt the efficacy of pruning to become their own judges of the art. Let them examine plantations where judicious pruning has been performed, and compare them with plantations that have either been improperly pruned, or not pruned at all. By this means they will be more readily convinced than by any abstract reasoning or advice.

For the sake of those who wish to obtain a knowledge of the principles and practice of pruning in detail, we subjoin the following instances at some length:—First, as applicable to hardwood trees; and, second, with respect to pines; specifying, however, only as many as may be deemed sufficient to illustrate the subject. The first case, when pruning may be considered necessary, is that of a hardwood tree on its being transplanted from the nursery to the forest, from a richer to a poorer soil, from a sheltered to an exposed situation, or from the tree having had the bark gnawed off by stock or game, or having become otherwise injured so as to cause it to die down to or near the surface of the ground, or the top having become dead, which latter occurrence frequently takes place in large trees, particularly if imperfectly rooted previous to transplanting. In this case, the only sure means for recovery of the tree is to cut it over. In small plants we cut to within an inch of the ground's surface, and the part removed off is stripped of the small branches, sharped on the thick end, and stuck into the ground close by the side of the stool from which it was cut off; this forms a future mark for the pruner when he goes over the stools in June or July to clear away from them all superfluous shoots, leaving only the strongest and straightest on each to form the future tree.

With regard to trees of more advanced growth, whose top has decayed, we cut off only the dead part back to where the stem is vital, allowing a leader to start from the strongest shoot upon the stem. This we often find of advantage where cattle or other animals would be likely to destroy the plant, if cut within their reach.

In transplanting large trees for ornamental purposes, we generally cut a portion off the top or reduce the number of the large branches; this not only lightens the top of the tree, and prevents the wind from having undue effect upon it, but also causes a larger quantity of sap to ascend what remains of the branches and top thus newly produced.

The next case we shall describe is that of a tree at various periods of its growth, from a sapling upwards, that has branched off into two or more stems. This occurs both when the tree is of spontaneous growth and also when it has been transplanted, but it must be admitted that it occurs more frequently in the latter case than in the former. When this occurs only with saplings, it may appear a circumstance of small importance, but it is far otherwise in the case of a tree when it attains any considerable size; thus, not only is the foliage deficient on the inner side of the two limbs confronting each other, but the tree is in consequence of the diminution of branches correspondingly injured in its roots. The tree in this form occupies an undue extent of surface of ground, and instead of becoming a beautiful and magnificent object, with a compact massive trunk, alike valuable and beautiful, develops itself into a mere collection of limbs and branches, radiating from two or more large ones, neither a subject for the artist nor useful to the mechanic. Nor is this the only evil that may arise from tolerating such a tendency in the growth of trees to go on unchecked, for it must be borne in mind that it is now a well-established fact that the roots of trees bear an approximate proportion to the branches, that the two run usually in the same direction parallel to each other, the one above and the other beneath the soil, so that in such cases the roots occupy as undue a portion of the underneath ground as the branches do of space above. Another conse-

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quence of the above result is, that the half of a tree which is unfavourably exposed to the prevailing hurricane is often blown down, and the remaining half shares a similar fate when the wind changes round to the opposite quarter to that from which it first blew. As a remedy, therefore, against this evil timely pruning is the thing required. In operating upon a sapling, we cut off at once the branch close to the bole of the tree, but if the limb or branches are too large in proportion to the tree, to admit of being cut off at once, we shorten it by degrees till sufficiently small to admit of being cut clean off. . Not only is the proportionate size of the branch to be taken into account, but the state of the tree's health at the time must be observed and studied, together with the situation in which it is growing.

These constitute some of the principal features to guide us in deciding whether the branches are to be reduced by degrees or cut off at once.

When a tree divides into a double top, at a height below what constitutes a good trunk or stem, we lighten one of the tops by cutting off about one-third of its entire length—that is, if the annual growths are large, the top much drawn up, and with few lateral branches upon it; but if the annual growths are comparatively short, say from 12 to 15 inches in length, and fully furnished with lateral twigs, we at once cut away close to the leading stem the less favourable-looking shoot of the two, and, in general cases, the one that would be most likely to be broken off by the prevailing winds in the locality. Pruning in this case is generally performed by means of the pruning-chisel, which is used to great advantage upon trees when beyond a man's reach. The chisel, which is made with a socket, is fastened upon a long handle by means of a screw-nail. The handle may be of any convenient length, from 8 to 20 feet, or upwards. The handle of the chisel, when sharply struck with a small wooden mallet, will cut even a large branch at a single stroke; and if the handle is perfectly straight, and fills the socket completely, the length of the handle does not diminish the force of the blow in any important degree.

It frequently happens that a tree, from some accident or other, loses its leading top at an early age; the consequence is, that a number of branches strike off in a horizontal direction, but none of them take an upright position, and this renders the tree quite a shrub of a somewhat pendulous and spreading appearance. A tree in this state would probably ever remain as a mere arboret, or bush, if left to itself. In this case, when hares and rabbits are not to be feared, we at once cut over the tree to within an inch or so of the ground. A young tree is thus allowed to form; and though the tree, when cut over, may be 6 or 8 feet high at the time it is cut over, yet in two or three years afterwards (if the tree is healthy) a young sapling will have taken its place, which, though not so strong, will be nearly, if not quite, as tall as the original tree, more handsome, more healthy, and better directed in its upward growth. A tree once fairly established in the ground will, when cut over, produce strong and vigorous coppice. From this the most promising shoot is selected for the future tree, choosing always that one which is lowest down upon the stool. If, however, as is frequently the case, hares or rabbits are to be dreaded, we cut the tree over at a point above their reach, and immediately below where a year's growth terminates, and where few branches exist. In cutting over close to a collection of spray or small branches, the sap is attracted to them, and the newly formed leading shoot is thus deprived of the requisite support to its proper development. A very common occurrence in this case is, that a quantity of spray is formed immediately below the cut part, particularly if the tree is at all unhealthy or of stunted growth. Trees thus operated upon in winter and spring should always be again gone over in the succeeding June or July, and all superfluous shoots broken off with the hand, which is better than the knife in ordinary cases; and when the woods are clear of game, we prefer adopting the former system, but when the reverse of this is the case, we

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adopt the latter, as the young shoots become at once a prey to hares, rabbits, and deer, and are seldom allowed to make a start over one year's growth, as the wood formed in the summer is utterly destroyed during the succeeding winter.

This kind of pruning is seldom necessary except in high and exposed situations; but under such circumstances we have often adopted it with the greatest success.

Another subject for pruning is, where a branch grows off from the main trunk of a tree at an acute angle, causing the bark to fester at the point of junction of the two surfaces. Trees thus affected become almost worthless for ship-building and other purposes in trade where good sound timber is required. True it is, that seldom are oaks of the best varieties affected with acute-angled branches, yet they are so occasionally, —even the Quercus robur, whose branches generally go off at almost right angles, is, in some cases, so affected. Since then we find nature producing branches of this description upon trees—and trees thus grown are ultimately nearly useless for ship-building purposes, at least, unless timeously denuded by pruning—art must, therefore, step forward and take nature by the hand, and guide her forward in the path most conducive to the convenience and interest of man; and in no instance can she do this more certainly, and with better success, than in cases such as the above. While the young sapling is within reach of the hand, we use only the common pruning-knife, but when above reach, the pruning-chisel must be used; and in doing so, we proceed in one of two ways—viz., when the branch to be operated upon is situated upon a tree of rapid top growth—that is, when the leading shoot is long and slightly drawn up, with comparatively few branches, we reduce the branch by cutting it back to about one-third or one-half of its entire length; on the contrary, when the tree is tolerably strong in proportion to its length, and is fully developed in its lateral branches, we cut off the branch close to the trunk at once. The object of this department of pruning is to obviate the consequences of the bark growing into the body of the tree, and to prevent high winds from splitting off the limbs at any future period of its growth, and also the injury that frequently occurs from the lodgement of heavy falls of snow upon the tree.

Another frequent case for pruning is, that of branches having become dead upon a tree. So long as the branches are vital, they are in a state of growth and enlargement, forming woody layers along with, and in some proportion to, that of the trunk of the tree whence they issue; but as soon as life ceases in the branch, the annual layers of wood upon the trunk, by continuing to increase gradually, encloses the base of the dead branch attached to it, and which, as it becomes enveloped in the wood upon the trunk, forms the much-complained-of *black knot*. If this occurs in a young tree, while the branch is a comparative twig without heart-wood, it soon decays and falls off, and no serious consequence arises from it, but when a large branch dies upon a tree after the heart-wood is formed in it, an evil of no small magnitude is incurred. The dead branch in this state remains upon the tree for many years, and until embedded several inches in the trunk by the increased annual layers upon it. The consequence is, that when the tree is sawn up into boards, a black knot is frequently found to go right through it, and on the wood being seasoned it frequently falls out, thus leaving a hole in the board, and rendering it useless for many purposes. Therefore, in all cases in young growing woods and plantations, we at once prune off all decayed branches from the main body of the tree; we do not care to prune them off large branches, or even small limbs, but only off those parts of a tree yielding timber. In pruning off dead-wood from young trees, we use only the pruning-knife or chisel; but when the trees are aged, and the heart-wood formed in the branches, the operation is performed by means of a ladder, hand-saw, and spoke-shave. With the latter instrument we carefully smooth over the surface of the knot where the branch existed, clearing away all decayed matter around the part where the bark comes up to. We then paint over the

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dressed knot, in order to prevent decay in the tree, to protect it till the bark covers it quite over, and to bring the knot to the natural colour of the bark of the tree. White lead mixed with oil, a little lampblack and red ochre, serves in most cases for this purpose, and may be mixed to any required tint. The most efficient preservative against decay in trees is an application of Archangel tar. For trees of a dark-coloured bark we prefer tar to paint, taking care to apply it sparingly in hot weather, as it is apt to run and spread if laid on thickly. White lead alone is often most like the lichen upon the bark of old trees, and for any conspicuous part it may be made an excellent imitation. We do not recommend the practice of taking off dead limbs or large branches from old ornamental trees; such treatment we regard as a needless interference with nature. Just as proper and natural to pluck the silvery locks from an old man's beard, to improve his look, as to remove the hoary, romantic, and picturesque arms from an old tree, particularly the "brave old oak," whose venerable age has won him renown.

It frequently happens with trees standing singly, by removal of others from them, that at some particular part upon the stem a great number of branches are developed, and, in consequence of this, that part of the trunk immediately beneath becomes disproportionately thick in comparison with the part above where the branches occur. The sap is thus in a great measure obstructed in its ascent to the uppermost branches, and the top of the tree is cut off from its due measure of support and enlargement. In order, therefore, to guide the sap in a proper direction up the tree, this profusion of branches must be diminished. In doing so, we cut a few of the small branches clean off close to the main stem, and reduce the larger ones about one-third of their entire original length, taking care in all cases of shortening to cut close above another branch or small twig growing upon it, in order to preserve the branch alive, and also to conceal the cut part. In pruning within policy grounds, or in sight of carriage drives, considerable art is required, so as to conceal from view the wounds inflicted upon the tree. When above the level of the eye, it is necessary to cut on the concealed side of the branch, and, in general, so as to be least observable. In a very important sense, pruning ought to be performed and regarded as a species of pilfering.

This case applies principally to young trees, and the object to be attained is their proportionate development, as a remedy against undue enlargement of the tree below the mass of branches, by diminishing which the sap is induced to ascend so as to nourish and enlarge the more slender part of the tree above. It is frequently indispensable to have timber from trees which have a clear, straight, and tall trunk, free from knots and clear of lateral branches to a considerable height; and in order to attain this in the most perfect way, the trees should be grown only at such distances apart as sufficiently to check the side branches when young, and a few trees gradually thinned out at a time; but this practice, from reasons well-known, is often found impracticable. The only alternative, therefore, is to assist nature in clearing the bole of the tree of all lateral branches. It is often difficult to say what the truly natural habit of trees is, as soil, climate, and situation have each a powerful influence in altering their appearances, and even their qualities. We find that when trees are grown singly, and are fully and openly exposed to sun and air, they are in most instances clothed with branches from near the surface of the ground to the top, so that the aid of art is called in to assist in producing a clear, tall, handsome, and useful tree. Pruning in this case might be almost, if not altogether, rendered unnecessary by timely and judicious thinning; yet, as already stated, this in the general management of woods is found impracticable, and consequently pruning is rendered a necessary operation. The operation of clearing the bole of a tree is the simplest of all departments of pruning, and is performed upon young trees with the pruning-knife; but in the case of tall trees and those further advanced, the pruning chisel is employed. As a general rule, the trunk of the tree is kept clear of branches to

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about one-third of its entire height: thus, a tree 30 feet in height should have a clear trunk of 10 feet, and a tree 60 feet high a trunk clear to 20 feet. In low-lying sheltered situations, where the soil is deep, the trunk of the tree may be cleared to nearly half its entire height. Though this is the simplest process of pruning, yet it is in many cases sadly abused by clearing the tree of its branches too near the top, and roughly doing the work. It is often necessary, although not desirable, to prune trees in hedges, and along avenues, rides, carriage drives, and roadsides, not with the object of benefitting the tree, but only to check the growth of the branches, and prevent them from unduly hanging over, thus shading surrounding crops, and impeding carriage upon roads. In this case the principal attention and observation required is, to lop off the offending branches without imparting to the tree a mutilated or manufactured appearance, to cut each branch so as to leave the part remaining upon the tree in such a state as sufficiently to elaborate the sap and maintain vitality in, and impart nourishment to, the tree. In the operation itself, sometimes the saw and spoke-shave, and sometimes the pruning-chisel is used, but in either case the greatest skill is required in amputating the branches in such a manner as to be altogether unobserved. In this department of pruning no positive definite rule can be laid down as applicable to all cases, as the entire execution of the work depends upon the taste and skill of the operator. We always cut either close to the trunk of the tree, and dress and paint the knot so as to avoid observation, or cut at such a distance from it as to secure and maintain vitality in the branch, and preserve the symmetry and outline of the tree. In amputating a large limb we always endeavour to do so within an inch or so of a smaller branch, and thus many a noble tree is preserved from falling a victim to the woodman's axe, or being subjected to a tortuous mutilation. We should wish to dwell upon this point of pruning, and would do so but for want of space. It is remarkable how proprietors of cultivated minds and refined taste can tolerate the unskilful and distasteful manner in which handsome and often noble trees are so outrageously disfigured by unscientific and inartistic pruning. But, as already remarked, this instance of pruning is not performed with a view to improve or benefit the tree, but simply for other yet very important reasons.

In the case of one large branch, or a number of branches, starting and growing upon one side of a tree, such branch or branches, from being disproportionately large, attract an undue amount of nourishment to themselves; thus a tendency is created to overbalance the tree by an excessive weight of branches and foliage on one side. A tree thus unequally balanced increases in woody matter on the side to which it inclines, and this evil is increased two-fold; as the tree advances, it extends and establishes its roots most upon that side upon which the greatest number of weighty branches are situated. The seemingly unimportant circumstance, which commenced in a disproportionately large branch, soon becomes magnified to such an extent as to terminate in very mischievous results. A reclining tree occupies several times the space that an upright one would do. It is more subject to be loaded and broken down with snow, it is unequally rooted, being deficient upon that side where fewest branches are situated, and, consequently, more subject to be blown down with winds, the annual layers of wood being much thicker upon the under than upon the upper side of the tree. The timber manufactured from such trees twists and warps in such a manner as to render it useless for many important purposes, therefore the necessity of pruning in order to properly balance the tree.

It sometimes happens that, from the weight of fruit or foliage upon a horizontal branch, from lodgement of snow, or some other cause, that a branch or limb is so bowed down as to rest upon another below it, and from the friction of the wind, the two branches are rubbed upon each other, often producing irritating sounds upon the ear, mutually disfiguring each other by friction, destroying the foliage of the branch upon which the upper one rests, which, from an undue weight upon

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it, also presently gives way. During heavy falls of snow, we have seen many noble trees thus all but totally destroyed, which, by attention to the removal of such branches in due time, might have been entirely prevented.

REMARKS APPLICABLE TO HARD-WOOD PRUNING.

The oak, which generally stands first in the class of hard-wood trees, and may be looked upon as the kind of tree which pruning most benefits, may, at some period of its growth, come under one or other of the cases of pruning previously laid down. One individual tree will, however, seldom or never embrace more than two or three of the instances cited; when each case has been carefully studied and understood, any intelligent person will perceive at once which of them applies to the subject under operation. What applies to the oak is equally applicable to the ash, elm, beech, lime, sweet chestnut, hornbeam, and mountain ash—that is, any one of them may be pruned at any period of the year except during frosty weather, except in cases when the plants require to be cut over close to the surface of the ground, and in such cases we prefer doing the work either during the last week in February or the first week in March; because if a plant is cut over late in summer or early in winter, it is so long exposed to the wet as materially to retard, if not entirely to prevent, vegetation. The sycamore, great maple, lime, and birch, &c., we prefer pruning during the months of June, July, August, and September, when the sap is most active, and when the solar heat has the greatest influence. The sun, during this season of the year, produces also a hardening influence upon the newly inflicted wounds, which by this means are sooner healed up, as the bark then more quickly covers the wounds than if pruned at any other season of the year. In order to test the effect of so doing, we have pruned sycamore and birch during December, and have found them bleeding from the wounds during the succeeding April and May. But we have never found any injurious results from pruning during summer and autumn.

At that season of the year, when the sap-wood is maturing, there is least danger of spray being produced from the wounds, and equally so of the tree bleeding.

II.—PINE PRUNING.

Assuming that the principles upon which proper pruning should be conducted is laid down sufficiently plain in the foregoing statements, as applicable to hard-wood trees, we need only further add a few remarks upon that other branch of the subject—viz., pine pruning. In consequence of the difference of the growth, constitution, and nature of the pine as compared with those of hard-wood trees generally, pruning coniferæ is rendered a practice much more difficult, and in most cases more or less hurtful. It is upon consideration of this delicacy alone, and not from the habits or development of the trees outwardly, that pruning coniferæ is so essentially different and opposed to the pruning of hard-wood trees. When we take into consideration the difference of the ingredients which constitute the fluids of trees, such as gum, sugar, turpentine, resin, &c., it is not a matter of surprise that pruning should produce such varied and opposite effects, nor is this more evident in any instance than it is by artificially exciting the growth of pines and thus deranging the natural course of the fluids; and it is immaterial whether the subjects operated upon are transplanted trees or those of spontaneous growth, the results in either case being much the same.

Artificial manures, undue richness of soil, excessive moisture, and pruning, each produce results to the pine hurtful in their way. In a brief account of pruning, such as this, it would be out of place to enter minutely into details upon the crystallizing process which the fluids of pines undergo on being disorganized or deranged in their functions. We will, therefore, simply state the effects that have been produced on pine trees pruned under various circumstances and in different ways. First, we have found pruning of very decided advantage to pine trees below fifteen years of age, in the way of relieving them of double stems or double tops. The advantage gained to the pine tree is similar to that gained by

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hard-wood in relieving the double top; we consider this the most beneficial of all pruning applicable to pines, and of all others is most frequently called into requisition, especially for silver fir (Pinus picea), as this tree is very liable to grow with a double top, which is deleterious and hurtful by splitting.

A second case in which pruning is of advantage to pines, is in pruning off the dead-wood. From the circumstance of this tribe of tree being planted closely together in masses and groups, in order to become most useful for the purposes of art, the growths of the lateral branches are soon so much checked as to cause them to wither and die, and in this decayed state they will remain upon the tree for several years. The trunk of the tree meanwhile enlarging, the dead branches become covered over with the annual layers of wood, and thus black knots are formed; and when boards are sawn out of trees thus affected, the knots in the boards, when they are seasoned, drop out, leaving a hole through them as if cut out with an auger. When the dead branches, however, are removed from the trees immediately on becoming decayed, the lesser of two evils is the result—viz., a dark spot only instead of a hole, which may in most cases be regarded as of small importance, except in very thin deals, when they may partially appear on both sides, though seldom even then. Pruning, therefore, under such circumstances, is of a very decided advantage to pine timber.

Third—Another system is pursued in the treatment of coniferæ—viz., that of pointing or shortening the side branches, in order to promote the top growth of the tree. We have made several experiments of this kind of pruning in order to satisfy ourselves on this point, and the result of the experience is to convince us of its inutility to accomplish the object in view, irrespective of its impracticability in the forest. We have, on various occasions, headed back the side branches of trees growing up side by side with others which had not been pruned, and, at the expiration of four or five years, on comparing their respective growths, have found that the trees which were not pruned had made growths equal in length, and rather stronger than those which were operated upon. However, if for any particular reason apart from economy and utility it is desirable to check the side growth of pines, we would, in every case, pinch off with the hand the buds or tender shoots.

Fourth—Any pruning performed upon the branches of coniferæ should be done during September or October, as during these months the fluids are in a more fixed state, and are not disposed to ooze out so freely as earlier in the season; and if deferred till winter, the wood being in an expanded state during frosty weather, a greater portion of it would become decomposed before the bark covers over the wound than if the operation had been performed in autumn.

As regards the pruning of dead-wood, the case is materially different, no wound being thereby inflicted in the vital part of the tree, and, consequently, the fluids remain undisturbed. One reason, however, for pruning off dead-wood in spring and during summer, instead of during the colder months of the year, is in consequence of the tendency it has of lowering the temperature of the plantation; dead-wood probably produces that effect more completely than any moderate degree of thinning could do. The benefit, however, arising from pruning off decayed branches from pine and fir timber is so great, compared with the evils that can arise from it, that in all cases, when practicable, it should be adopted.

REMARKS APPLICABLE TO PRUNING CONIFERÆ.

In several instances we have headed back pine trees under twelve years of age. In some cases where the top had been injured, we headed them back with a view to induce a fresh leader to form, and in other cases we have headed them back by cutting off sometimes one and sometimes two or three years' growths, in order merely to observe the results; and, in every case, within a few years, symptoms more or less unfavourable made their appearance. The top, in some cases, died back the second year to where it had been cut over, and, in other cases, the trees either

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lost much of their previous vigour of growth, or became covered over in their stems and branches with resinous globules. We headed back some larches, by cutting off two or three years' top growths, when the trees were about six years planted. The trees were growing at an altitude of about 600 feet, and the top shoots were about 18 inches in length. This was done with a view of testing the effects of a stimulated growth upon the trees, when within four years from the time of the operation, there was a decidedly visible superiority of growth upon them compared with those that had not been cut. Nothing, however, is to be gained by top-cutting of larch, but, on the contrary, considerable loss and risk; hence, it should not be practised. It is further suggested in reference to pruning, that no branch be cut from a tree that is not doing positive harm or injury to it, and that every branch is a source of nourishment to the tree, and every leaf a medium through which the tree is supplied with the elements which nourish it.

Spray or young shoots formed after cutting off branches, though vigorous and healthy at first, will, unless the tree is in a very vigorous state of growth, wholly or partly, die or grow sickly, the second or third year, and the once broad healthy leaves, which pruning was the cause of producing, become only a poisonous provocation to the plant.

Diminishing the number of branches upon a tree is an indirect way of preventing it from procuring food for its support and development. Let no decayed limbs or horns be removed from very aged trees unless broken or otherwise disfigured, but let damaged live branches be removed in every instance. No pruning can be considered practical and efficient that does not interpret and clearly explain itself, and no person is capable of judiciously pruning who cannot give a good and intelligent reason for so doing, by explaining it, if not in scientific terms, at least in a manner agreeable to science.

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VI.—*ON THE THINNING OF PLANTATIONS.*

BY WILLIAM GILCHRIST, FORESTER, CLUNY CASTLE.

THIS is one of the departments of Arboriculture which periodically, to a greater or less extent, engages the attention of all who are connected with wood-management. Yet, strange to say, there is no subject connected with the profession that has given rise to so much, and exhibited so great a diversity of opinion, each of which being held most tenaciously by its respective supporter, to the entire condemnation of all who venture to uphold opinions to the contrary. Still, this variety of opinions is just what is to be expected, seeing that so many practical foresters hold what may be termed localised opinions in regard to thinning—that is, their ideas are derived, not from an understanding of the physiology of trees, nor from a knowledge by personal study of their different habits and requirements, but from what has been the practised system on the estate or district with which they are connected, or perhaps what is recommended by some local mandate—all of which may be perfectly right in the district or situation in which they are practised, and yet be wrong if generally adopted. In fact, there is no operation that is more difficult for the practical forester to describe than the thinning of plantations, as what may with safety be adopted in one plantation, would be quite unsuitable for another. Therefore, it may be as well to state, once for all, that no definite rule for the thinning of plantations can be given, as so much depends upon local circumstances, situation, altitude, exposure, &c.; and even general rules are apt to mislead the inexperienced, unless they are formed on a broad and liberal basis. Therefore it would be well for the country, and well for the cause of arboriculture, if proprietors of woodlands would make themselves thoroughly acquainted with the art of thinning, so that they might know at a glance whether those men who are intrusted with the management of their woods are doing right or wrong. This is the more necessary, as many an intelligent forester with good ideas on the subject, is deterred from carrying them into practice, owing to the coldness or apathy with which these operations are looked upon by proprietors and their agents. But it is cheering to observe that this indifference on the part of proprietors, in regard to thinning plantations, is beginning to give way before the enlightenment that is being diffused throughout the country by different agencies, but principally through the agency of the Scottish Arboricultural Society and its members. But enough of this preamble, and to the case in point, which we purpose to consider in the following order:—The advantage of thinning plantations; the proper time for thinning, and general method adopted; its effect on different situations, altitudes, and exposures.

I. THE ADVANTAGE OF THINNING PLANTATIONS.

It is often remarked that there is no necessity for, nor advantage to be derived from, thinning plantations, seeing that the best timber, both home and imported, is got from natural forests where no such thinning has been practised, and also that thinned plantations produce rough timber of little value, as compared with the tall clean-grown trees that are got from unthinned plantations. These arguments have been a stumbling-block to many, and at first appear to be strong opponents to those who would practise the art of thinning. But on full inquiry and examination they become more imaginative than real. Unthinned plantations may produce tall clean-grown trees, for which a large price may be got in manufacturing or mining districts; but they are mere "spars," and not one of them in a hundred ever come to be timber trees, and few of them at 70 years old are found to be in a healthy or thriving state. And again,

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in plantations that have been formed by the modern planter, the trees are generally planted at from 3 to 4½ feet apart, and equally distributed over the ground. Their tops, therefore, generally rise at a uniform rate, and are about the same height during all the stages of their growth, thus presenting a striking contrast to the arrangement of the natural forest.

The natural forest, at first sight, may appear a mass of confusion, and no doubt it would be benefited by judicious thinning; still the arrangement is such as tends to encourage and promote the growth of large and valuable timber. For in all natural forests, both at home and abroad, the trees are of different sizes and ages, and are not distributed so equally over the ground as they are in those plantations that have been planted artificially; but there is generally a sufficient number about one size to form a crop. Taking the number of plants on the ground, they are often not above 2 feet apart, but they are of different sizes. The smaller ones may be overtopped by their larger neighbours, still they are not greatly injured, as their tops are not of a uniform height; they only act as nurses to the larger ones, and are the means of keeping the side branches of the latter in check. Thus it is that natural-grown timber, whether hardwood or pine, is generally so clean-grown and free of knots. Of course there are exceptions to this, as in the case of natural-grown trees that have been grown singly, or have had plenty of space for the spread of their side branches.

Now, if we consider the difference (at all stages) between natural forests, where the trees have been unequally distributed through the agency of the winds or birds carrying the seeds, and plantations that have been artificially formed, and the plants distributed at equal distances over the ground, we shall at once see, that although there is no particular necessity for thinning the natural forests, the necessity for thinning the artificially formed plantation is very great. In fact, the ultimate success or failure of these artificially formed plantations depends upon their being thinned regularly and in due time. To neglect it till such time as the thinnings are of some value is simply hastening on premature decay.

Some theorists, to avoid thinning, have recommended the planting of young trees at 9 or 10 feet apart. But, except under very favourable circumstances, this recommendation must be considered as mere theory, quite unsuited for general application in the management of plantations, the best and most practical way being to plant the young trees at from 3 to 4½ feet apart, according to circumstances, and to thin out the inferior trees periodically as required. This is the more necessary, as it is no uncommon thing for even young trees, either from accident or some other cause, to die out, thus leaving, in the case of trees planted at 7 or 10 feet apart, an open space of 14 or 20 feet—certainly a very wide space for young trees.

Numerous examples could be given illustrative of the difference between thinned and unthinned plantations, or rather the difference between trees that have been allowed sufficient space, and trees that have been confined and over-drawn; but it is quite unnecessary, as every unprejudiced forester can find ample proof of this on almost every estate, from the nursery to the matured plantation. Examine a line of plants (of any description) in a nursery, and it will be found that the plants that have most space are, if not the tallest, the strongest and healthiest. Examine any plantation, and compare the trees that have all along had plenty of space for their free growth, or that have been grown on the sheltered side of a plantation—I say, compare these with trees in the same plantation, that have at some period been over-drawn, and the result will fully demonstrate the advantages of thinning.

Thinning, or the providing of sufficient space for the development of trees, to be beneficial, must be practised in the nursery as well as in the plantation; for there is no doubt but that a great many forest trees are constitutionally diseased by being overcrowded in the nursery lines. And arboriculturists would do well to take a lesson from the natural forests in this respect, as no such crowding of the young trees is to be found there. This over-crowding of the young trees in nurseries is the result of com-

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petition and the demand for plants at a cheap rate—in fact, a cheaper rate than it is possible for any nurseryman to rear good plants profitably. And even in home nurseries, that have been formed ostensibly for the purpose of rearing good healthy plants, the plants are too much crowded, and for no other reason than that the forester has seen them growing in a like manner in the public nurseries. Better far for those who wish to grow healthy and profitable trees, to pay double the price, or even more, and get good plants, that at no period have been over-crowded or checked in their growth. For if once a tree, at whatever period or stage of its growth, has been checked by being over-crowded, it takes years to recover, and if the check has been severe, it never attains to the dimensions it ought to do. Therefore, to realise the full benefits of thinning, it must be begun in the nursery lines, and continued periodically in the plantation.

When the larch disease first made its appearance in this country, thinning and draining were the remedies practised and recommended by the most intelligent foresters, and in some instances with very great success. And at the present time, larch plantations that are regularly and periodically thinned are almost free of disease, healthy, and in a thriving state; while the contrary is the case with larch plantations, where thinning has been neglected. The spruce and silver firs are also very much benefited by regular periodical thinning, and will grow to a great size, and become very ornamental if allowed plenty of room for development; but if overdrawn and confined, they grow up mere "spars," for which but a very small price is realised. To particularise all the trees that are benefited by thinning would only be extending this paper to unnecessary length. Suffice it to say, that all artificially-formed plantations are benefited by regular periodical thinning, and if, added to this, a divisional or rotation system is introduced into the management, an increased revenue will clearly demonstrate the advantages of thinning.

II. THE PROPER TIME FOR THINNING AND GENERAL METHOD ADOPTED.

This part of the subject naturally divides itself, and must be considered according to the different plantations that generally come under the notice of the practical forester.

1st. *Hardwood Plantations.*—These are generally formed of different varieties of trees, each of which, according to its habit of growth, requires a different treatment. But in a paper like this they can only be treated collectively, or as a mixed hardwood plantation.

Hardwood trees are generally planted at from 4 to 5 feet apart, and thinning, or rather pruning (for we consider that, in the case of hardwood plantations, thinning and pruning must go hand-in-hand), should begin in four or five years afterwards, or as soon as the trees have got fairly established and have begun to grow freely. This pruning consists in simply keeping the side branches in check, so as to keep the tree within proper bounds and in equal proportions; cutting off all extra leaders, and shortening all branches that incline to take the form of leaders, leaving only one leading shoot, and preserving, as far as possible, the upright form of the tree. This system of pruning should be done at least every second year; or if done every season, it takes very little time, and is not so severe a check on the young trees as when it is not done for a longer period.

After the plants have been nine or perhaps twelve years planted, according to the situation and size of the trees, it is necessary to select the trees that will be taken out at the first thinning. This done, they should be subjected to severe pruning of the side branches, so as to give free space to the trees that are to be left. The trees to be taken out at the first thinning are of comparatively little value; they should therefore be kept growing as nurses for the others as long as practicable, only their side branches must be kept well cut back so as not to interfere with the other trees.

When the plantation has been for the first

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time thinned, by taking out the trees that have previously been severely pruned, the trees will stand at from 8 to 10 feet apart, and in a few years will again begin to encroach on each other; therefore the trees to be taken out at the second thinning must be again selected and treated in the same manner as before recommended. Young hardwood trees treated in this manner receive no check from thinning, and in a given time—say, fifteen or twenty years—will grow at least a fifth larger, both in girth and height, than trees treated in the ordinary way. When they are about thirty years old, they will have received their third or fourth thinning, and may then be standing from 16 to 20 feet apart, with good leaders and well-formed tops. At this stage they should be allowed to get a little drawn, so that they may be cleared gradually of their lower branches.

In hardwood plantations where coniferous trees are used for nurses, they must be treated in the same manner. No doubt, it is most injurious to prune or cut the side branches of coniferous trees, but at that stage of their growth they are of little use, and the cutting back of their side branches allows them to grow for a longer period, and prevents the thinning from being any check on the young hardwood trees.

In selecting the trees to be left, great care must be taken to leave the best and healthiest; and even though the permanent crop be intended to be exclusively hardwoods, a healthy coniferous tree should at all times be preferred to an unhealthy or unshapely hardwood one. It will form no eye-sore in the plantation, but, on the contrary, if it be an evergreen, may, in course of time, be a very pleasing and agreeable object, and be prized even more than any of the hardwood trees.

2nd. *Old Hardwood Plantations.*—These are to be found on almost every estate, some of which appear to have been regularly and systematically thinned in due time, while others appear to have been totally neglected, or at best done in a very haphazard manner. With these old plantations little can be done in the way of regular or periodical thinning; but a great deal can be done by occasionally taking out a tree here and there, whenever they seem to be encroaching on any of the finer specimens, always taking care that the specimens are not exposed or opened up too suddenly. For, when a tree at this stage gets a severe check, it seldom recovers its wonted vigour, and although it may remain green for many years, it will make little progress, and is ultimately doomed to premature decay.

Sometimes in thinning these old plantations, the best and most valuable of the trees are taken out, and the rough and worthless ones left to keep up the appearance of a plantation. This system should never be practised or encouraged, except when it is absolutely necessary for the sake of revenue or wood for estate purposes. Hardwood trees that have been regularly thinned in their early stages, and then left to mature and get a little drawn, must be very cautiously dealt with, as they are just at the turning point when the questions, profit or loss, success or failure, have to be decided. So much depends upon the appearance of the plantation at this stage, that we dare not hazard a remark as to the probable time it will require to be thinned. Caution must be the practice and watchword of the forester, who at this stage ought never to cut a tree except it be *back-going*, or the welfare of some of the intended standards require it. Some hardwood trees can be grown much closer together than others, as, for instance, the ash and elm, which, though naturally of a wide-spreading habit, to be grown profitably, must be kept a little confined; whereas those trees that are naturally of an upright habit require to be allowed more space, so that they may grow to girth as well as to height. All these details must be fully realized and understood by those who are entrusted with the management of plantations.

Copse, or underwood, is often to be found growing in these old plantations, and, instead of being partly encouraged, it is often subjected to the cruel password, "no quarter." This ought not to be where the motto is, "Aye be sticking in a tree; it will be growing when ye are sleeping." This copse, or under-wood,

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when properly thinned out, and treated similarly to young trees, is not only ornamental, but it is useful and beneficial to the health of the older trees, especially in exposed situations, as it breaks and tempers the wind and storm, and prevents the trees from becoming stunted and bark-bound. Those who periodically practise the "no quarter" system with copse or underwood that is growing amongst old trees, ought to take a lesson from the frontispiece of the Scottish Aboricultural Society's *Transactions*, where, in one group, is represented the seedling and the monarch of the woods; and therein consists the true art of thinning and managing these old plantations—viz., to take out from time to time the old and matured trees, and have younger ones coming up to fill their places, so that the old ones may be scarcely missed; and, above all, that there be no great blanks, and the trees that are left not too much exposed. The copse or underwood should be thinned out at an early stage, and pruned, similar to what has been recommended for young hardwood trees. But no pruning ought to be done to the old trees, further than keeping them clear of dead wood.

3rd. *Fir Plantations.*—In the present backward state of arboriculture, when so little is practised or known about the chemistry of trees, and so many conflicting opinions exist regarding the suitability of different trees to the various soils, situations, and exposures that are to be found in Great Britain, it is no uncommon thing to find three or four varieties of fir trees in one plantation all mixed, or perhaps in rows of larch and Scotch firs alternately. And if the plantation is even of moderate extent, there will be as many, if not more, varieties of soils and situations, some of which may be suitable for growing one kind of tree, and quite unsuitable for another. And herein consists the necessity for the practised and experienced eye to direct the thinning of the plantation, so that the varieties that are unsuitable, and not thriving, may be taken out at once, and the varieties that are likely to be suitable for the situation left.

Whether it is best to grow coniferous trees in mixed or unmixed plantations is a question that has often been discussed amongst practical foresters, but without any definite answer to the question being arrived at. In fact, a good deal can be said in favour of both methods; but until more is known regarding the chemical ingredients of the soils, and the requirements of the different varieties of plants, the safest method—more especially as larch is now such a precarious crop—is to encourage the planting of mixed plantations. By this means the varieties of trees suitable to the different situations can be arranged, and selected at each periodical thinning, much better than it is possible to do, under present circumstances, at the time the trees are planted.

These remarks are a digression from the subject, but are only mentioned to shew the importance of having all thinning operations conducted under the superintendence of thoroughly practical men, who, although they may know little about the science of arboriculture, have, by experience and observation, acquired a practical knowledge which volumes of books or essays on the subject could neither instil nor supplant.

The first thinning of fir plantations, under favourable circumstances, sometimes takes place as early as five or six years after they are planted. This first thinning consists in cutting down all bramble, briers, whins, or other natural-growing plants that have a tendency to grow rank and choke up the young trees; also cutting over all young trees that have been damaged by the ravages of game or otherwise permanently injured or deformed; and wherever two or more healthy trees are growing closely together, one of them should be removed and planted in some of the blanks or open spaces. In fact, the first thinning of fir plantations is simply a rearrangement of the plants, and clearing of brushwood, so that the plants may be distributed over the ground as regularly as possible. It may be here mentioned that it is absolutely necessary, for the growth and future development of the trees, that all natural brushwood should be kept cut down that has a tendency to overgrow

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the young trees, and rob them of their nourishment, or prevent the free access of light and air to their lowest branches.

The next general thinning must be done before the trees are so close as to injure each other. Perhaps the whole of the plantation may not be ready for thinning; but no matter, for thinning at this stage will brook of no delay. Some individuals insist that at no time should the branches of one tree be allowed to touch another. But this is rather an extreme view, as fir trees at all stages may touch each other without injury. Were it otherwise, young fir trees would often require to be 30 feet apart when they are twenty years old. Pruning cannot be practised on fir plantations as an auxiliary of thinning, but pointing and disbudding takes its place; and few, unless those who have practised it, are aware how beneficial pointing and disbudding the side branches of fir trees is. It keeps the side branches weaker, and makes the tree grow tall, clean, and symmetrical, and will ultimately produce a more valuable and better quality of timber.

In thinning fir plantations, a method similar to that recommended for hardwoods may be adopted, only pointing and disbudding cannot be so severely done with firs as pruning can be done to hardwoods; therefore the periodical thinnings should be done at shorter intervals, say every third or fourth year, if the plantation is in a thriving condition, and the situation moderately sheltered. Attention should at all times be given, so that the trees may be distributed and left at as regular distances from each other as possible, consistent with the proper selection of the healthiest and most suitable trees for the permanent crop. With this end in view, the forester who would aspire to be an adept in the art of thinning must take a comprehensive view of the whole plantation, and ascertain at what distance apart the different varieties of trees, as suited to the different situations, would require to be when they have been thinned for the last time. Having ascertained this, the selection of the trees to be taken out may be made accordingly, always keeping in view what trees will be suitable for taking out at the next periodical thinning. By thus exercising a little forethought, a standard tree can often be relieved by taking a few branches off the intruder, and thereby allowing the standard tree the full benefit of the shelter for a longer period. As the intruder will probably be taken out the next time, it will not be materially injured, or deteriorated in value, by having a few branches cut off. This regular and progressive system of thinning plantations during the earlier stages of their growth, when the wood is of little value, entails more expenditure for the time being than is ordinarily required for the management of young plantations, but the extra expense of management will be fully repaid by the extra quantity and quality of timber that will be produced at a future period. Were it considered necessary, instances of the expense of thinning young plantations at different stages could be given; but as these are so dependent upon local circumstances, and the demand or market that may exist in the district for thinnings, we refrain. Suffice it to say, that the writer has thinned mixed fir plantations at eleven years old, and sold the thinnings at 4s. per 100 lineal feet, measured up to 2 inches diameter at top; and again, he has thinned similar plantations eighteen or twenty years old, where the trees would not be taken out of the plantation after being cut, though offered at a merely nominal price. Had the trees in the last instance been in the same district as the former, they would have been worth a third more money.

The trees on the outside or exposed parts of the plantation should at all times be kept apart, so that they may be well furnished with branches almost to the ground. No matter though they should be considered mere "scrags," they will be firmly rooted, and so produce shelter to the interior, and be able to withstand the severe storms that occasionally sweep across the country, carrying ruin and devastation into many a healthy and thriving plantation that might have been saved, had the outside trees been able to withstand the fury of the blast.

Mixed fir plantations ought in general to be periodically thinned until they are from thirty

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to forty years old, at which time the most of the trees will have been taken out, except what is intended to remain as the permanent crop. These should be standing as near as possible at regular distances apart, say from twelve to eighteen feet, or if spruce, perhaps even twenty-four feet, according to the different situations, and the requirements of the trees. After this period little requires to be done in the way of regular thinning, except to take out any trees that may appear to be going back before they lose value, and also any tree that may be injuring any of the best specimens. But at this stage in the management of plantations, the great object should be to allow time and space for the maturing of the wood and the proper development of the tree, so that when the time comes for reaping the crop of trees, the proprietor may have the satisfaction of finding the balance on the right side of the ledger.

4th. *Old plantations, where thinning has been totally neglected.* — These, to a greater or less extent, are to be found in almost every part of the country, and often in situations where, if due care had been taken, a first-class crop of trees would have been the result. But they seem just to have been planted and then left to fight their own battle for existence, the strong-growing varieties over-topping and injuring the others, until the whole becomes unsightly, and a perfect mass of confusion. Then it is that the aid of the forester is called for; the plantation looks sickly and appears to be going back, and really it must require thinning. These are the general ideas and remarks, and are too often concurred in by practical men who ought to know better.

If the most of the trees are beginning to shew signs of premature decay, very little can be done further than taking out the dead or decaying trees, for the sake of appearance and before they lose value; for to attempt to thin, or regulate the distance apart of the trees, by severe periodical thinning, after the proper time has passed, is simply hastening on the premature decay that is already begun. This severe thinning of neglected plantations, whether they be mixed or unmixed, hard-wood or coniferous, deciduous or evergreen, after the proper time has passed, is considered to be one of the greatest mistakes made by foresters of the present day. It would certainly be better, if a quantity of wood is wanted, for estate purposes or for revenue, to cut out a portion of the wood at once, and leave the remainder in almost its natural state; to attempt to thin it at this stage, is simply laying it open to be blown over by the first severe gale that sweeps the country. Where a sufficient quantity of healthy trees to form a crop are to be found in these plantations, a little gradual thinning will be beneficial, only it must be very carefully done, and will require to extend over a series of years. In a plantation of this description (owing to the trees being so much drawn before thinning operations were begun), the standard trees intended for the permanent crop will require to be left much closer than trees of the same age and variety in plantations where a regular system of periodical thinning has been followed in the management.

Having selected the probable standard trees, the chief object to keep in view must be their proper development under changing circumstances, as few things are so susceptible of change as trees; therefore, only such as are materially injuring the standard trees ought to be taken out at first, and even these not all in one season. But, of course, those that are injuring must be taken out, even though they should be rather healthier than some that are left. Thus is the original shelter of the plantation kept intact as far as possible, and space provided for the proper development of the standard trees, whose growth, by the operation of gradual thinning, is rather stimulated than retarded. Numerous instances of the damaging effects of severe thinning of neglected plantations could be given; but they might be considered by some to be rather personal, and are quite unnecessary. Whoever wishes to test the accuracy of the foregoing assertions, will find ample scope and proof by examining the plantations that have suffered so much from the severe gales that have recently swept the country, totally annihilating or ruining some plantations, and scarcely turning a tree in

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others that were equally exposed. Whether plantations that have been regularly and systematically, and, in due time, thinned, or plantations where thinning had been neglected, and then severely done, have suffered most from recent storms, is a problem I leave for the impartial forester to solve, with full confidence as to the result.

After each periodical thinning has been finished, the drainage of the plantation should be attended to, as the open drains are often damaged and choked up with branches when thinning operations are going on.

The branches and brushwood of the trees that have been cut are generally left scattered all over the ground. These, besides being injurious to the growing trees, are a great inconvenience to the workmen at the next periodical thinning. They should, therefore, be moved at the same time as the wood. The people of the district are generally glad to get these branches for fuel, and if not, the rough of them can be taken out and burnt at very little expense. Where the preservation of game is considered important, these branches may be put up into small heaps to form artificial shelter, but they ought not to be left scattered over the ground, as they tend to encourage the growth of a number of the fungus tribe, all of which are detrimental and injurious to the growth of trees; and in these neglected plantations it is of the greatest importance that as much pure air be admitted as possible.

III.—THE EFFECTS OF THINNING ON DIFFERENT SITUATIONS, ALTITUDES, AND EXPOSURES.

To ascertain correctly the effects of thinning on different situations, altitudes, and exposures, the circumstances under which each operation is done must necessarily be the same, or as near as possible—that is, the plantations, though of different ages, must be about the same size, and the trees encroaching upon each other in a similar manner, in the different plantations, and the first thinnings of each have been done in due time, and in a similar manner. Examples corresponding to these circumstances are scarcely to be found. But, so far as can be ascertained, thinning, if properly attended to, is generally beneficial to plantations under any circumstances. However, where it is too long neglected, or too severely done, its bad effects are most apparent in exposed situations; and even some varieties of trees suffer more than others, but this is owing more to the trees being unsuitable to the situation, than to the effects of thinning. For instance, if the situation is sheltered, the common spruce and silver fir are greatly benefited by thinning; whereas, if the situation is exposed, these same varieties of trees are materially damaged. In fact, they will not survive thinning many years. But this is not the effects of thinning, as these trees are unsuitable for growing on exposed situations, and could not survive long whether they were thinned or not. The same may be said of the poplars, willows, alders, and limes. Even ash and elm, in some situations where they are exposed, and the soil unsuitable, are said to be injured by thinning. This is a great mistake, as all the varieties of trees that are suitable for growing in exposed situations are greatly improved, more firmly rooted, grow to a larger size, and live to a greater age by being thinned in due time.

A few examples will corroborate these statements. In an exposed situation, altitude 350 feet, soil light and thin, with gravelly bottom, a plantation composed of oak and Scots fir was not thinned until twenty-two years after being planted. The order was given to cut down all the Scots fir that were interfering with the oaks. This was done, and in a few years the growth of the oaks was at an end. This was said to be the effects of thinning, and no doubt it was, as, had the situation been sheltered, it might have been different. But the true cause was, that thinning had been too long delayed, and ultimately too severely done for the situation.

In a mixed hardwood plantation, at an altitude of 500 feet, situation undulating and partly exposed, soil light, resting upon whinstone rock, the whole of the varieties of trees in the sheltered situations seemed improved by thinning; but in the exposed parts, only the planes or sycamores seemed to be improved, while the ash and elm, and even some of the oaks, seemed to be injured, or, at least, severely checked in their growth. The thinning of the plantation had been

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neglected, and the ash and elm were quite unsuitable to the soil and exposure, so that the back-going state of these trees could not be attributed to the effects of thinning, although it was partly owing to the neglect of thinning.

A mixed fir plantation, in the same situation, that had been neglected, was partly thinned, and a portion left in the natural state. The latter portion continued to grow, to all appearance, just as it had done for years; while the former at once shewed symptoms of stunted and checked growth, and in a few years afterwards the wind broke in and destroyed it so, and nothing remained but to clear it out.

Young plantations in the same district, that are regularly and cautiously thinned, appear to sustain no check, but are rather stimulated.

In a mixed fir plantation, about twenty years old, altitude 450 feet, situation moderately sheltered, soil loam, inclining to clay, it was considered necessary that thinning operations should extend over five years, as the wood was to be used for estate purposes. This plantation had been once thinned before, and was so regular in its growth that it mattered little what part of it was taken first. But after the whole was finished the second time, a striking contrast was visible, the portions that were thinned first appearing to be much healthier and stronger than the last portion. In fact, to the casual observer, they appeared to be older trees.

At an altitude of 250 feet, situation sheltered, soil light loam, damp gravelly subsoil, a mixed plantation, containing a large proportion of spruce, was all much improved by thinning, but especially the spruce; they received no check, and the second year after being thinned the lateral growths were about double what they had been for a number of years previous.

A similar plantation, but in an exposed situation, subsoil hard retentive clay, was thinned about the same time, and in a few years afterwards there was not a healthy spruce tree in the plantation—in fact, they appeared to be turning worse and worse every year; while, in the same plantation, oak, beech, sycamore, and elm appeared to be greatly improved by the thinning.

A young hardwood plantation, in a similar situation appeared at an early age to be in an unhealthy state, partly owing to the ground being very wet. It was regularly thinned and drained, and is now, with the exception of a few ash and elm that are "stag-headed," in a thriving state.

A great many more examples could be given, the results of which all go to prove what has already been stated in this paper—viz., that thinning, if done in due time, is beneficial to plantations, and stimulates rather than retards their growth. But although thinning must be considered a very important part in wood management, it must not be considered all-important. On the contrary, the success or failure of plantations depends a great deal on the formation and the planting of such kinds of trees on the exposed parts as will withstand the storm, and shelter the interior of the plantation. The boundary line must also be laid off in a manner to resist and break the storm as far as possible.

These things are but little attended to by arboriculturists; consequently plantations do not thrive and give the satisfaction that they ought to do. It is generally after being thinned that they are discovered to be in an unhealthy state; and, without examining or inquiring into cause or effect, thinning is pronounced to be injurious to plantations, and is accordingly avoided altogether, or done when it is too late to be of any benefit. It is now a well understood and accredited fact, that cereal crops yield a heavier return when they are thin sown than they do when thick sown; and vegetables that have plenty of room grow double the size of those that are confined; and even shrubs, border plants, and bedding-out flowers, to luxuriate, must have room. And is aboriculture to lag behind, and seem to say that though every other vegetable product requires free space for its proper development, trees don't? I trust not, but hope that the day is dawning when the science and practice of arboriculture will be thoroughly understood and recognised as one of the most important of the rural arts.

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VII.—*ON THE CORSICAN PINE (PINUS LARICIO).*

BY JOHN M'LAREN, FORESTER, HOPETOUN HOUSE.

THERE are few sights more pleasing than a view from some moderate eminence: where, standing on its highest ridge, the surrounding country is seen rolling away in its endless variety of hill and dale, woodland and water. The eye rests with pleasure, here on the chequered cornland, there on the winding stream, glittering in the sun, or almost hidden in the thick mantle of wood which crowds its banks, as it threads its way to the sea. Or we trace the forests clothing the hill sides, and running in shade and darkness into the deep valleys, here and there relieved by gleams of sunshine breaking in upon the gloom of their hidden depth; while all around, nestling in the bosom of rich foliage, lie the dwellings of the landed proprietors—men whose refined taste and noble enterprise have materially added to the beauty and natural wealth of our country. As we descend, the extent of vision lessens, but the distinctiveness of the nearing objects grow upon the eye. The plantations, which before were vast masses of dark green rolling away over the plains or uplands, now throw off their general massiness, and begin to open their ranks for closer inspection. Then tree vies with tree, foliage with foliage, trunk with trunk; and questions of contrast, comparison, beauty, and usefulness insensibly take hold of the observer. Now, in this sensible pleasure, awakened by the landscape, the forest plays no mean part, for, were the country divested of its woods, immense sweeps of bare land would sensibly fail to awaken those emotions which spring from the view of a well-wooded district. We do not wonder, then, that to the man of taste and refinement, the introduction and cultivation of the best varieties of forest trees should ever be a question of deep interest and importance. Of their absolute necessity to our commercial interests, social progress, and household comforts, no one will doubt. While coal and iron are the bone and muscle of Britain's greatness, *wood* must ever, for mechanical appliances, form her great right arm.

Here, then, both the man of culture and the man of practical and utilitarian tendencies meet in one common desire for the cultivation and extension of those trees that are most useful and ornamental, and the question for our consideration is how best to introduce and propagate those kinds which possess these qualifications. In endeavouring so far to answer this important question, I will confine my remarks at present to the Corsican pine (Pinus Laricio). By those to whom this noble pine is familiar, its peculiar adaptation to our climate, its hardiness, beauty, and worth as a timber tree, will be frankly acknowledged; while to those to whom it is a stranger, it only wants a trial to render it a general favourite. The more extended introduction and cultivation of the newer coniferæ being a branch of arboriculture in which I have taken a deep interest; and having had, for many years, a considerable collection under my charge, among which figures the Corsican pine, I take the liberty of laying before the Scottish Arboricultural Society a short statement of my experience of, and the impressions on my mind arising from, the cultivation of this pine. These were planted here (Hopetoun) in different soils and situations, and in each case their progress, appearance, and promise are all that can be desired. The largest was planted twenty-five years ago in a light yellowish loam with a rocky subsoil, about 450 yards from the sea, and 100 feet above its level. It is now upwards of 41 feet high, with a straight clean stem, 4 feet 7 inches in circumference at 4 feet from the bottom, thus giving an average of 19½ inches in vertical

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growth, and 2⅓ in circular, per annum. A few other conifers were planted in the pinetum here (the soil is clay, with an admixture of sand, and a retentive subsoil), and, for the sake of contrast, I will now give a list of some of the most hardy under my care, adding to each plant its growth for a number of years. The order in which the names are given is that of hardiness, usefulness, and ornamentation, beginning with the first, although in some of the varieties it is difficult to give a preference to one over another :—

Picea Nordmanniana	grew	7	feet in	9	years.
„ nobilis	„	6	„	8	„
Abies Douglasii	„	12	„	10	„
Cedrus argentea or Atlantica	„	13	„	10	„
Wellingtonia gigantea	„	9	„	6	„
Pinus Laricio (Corsican)		14	„	11	„
Pinus Jeffreyii	„	5½	„	5	„
Pinus monticola	„	12	„	11	„
Abies Menziesii	„	12	„	11	„
Abies Morinda or Smithiana	„	9	„	10	„
Picea Pinsapo	„	5½	„	7	„
Cedrus Deodara	„	13	„	11	„
Picea grandis (of Loudon)	„	4	„	5	„
Pinus Benthamiana	„	9	„	9	„
Pinus Pyrenaica	„	5½	„	5	„
Picea Parsonsi or lasiocarpa	„	6	„	7	„
Pinus Austriaca	„	14	„	14	„
Pinus Cembra	„	10	„	12	„
Abies Albertiana	„	15	„	14	„
Pinus Strobus (Weymouth)	„	12	„	13	„
Abies orientalis	„	7	„	6	„
Abies Whitmaniana	„	8	„	7	„

Although it would be vain to attempt to uphold the P. Laricio as the most ornamental and useful, yet for general planting I have no hesitation in stating that there are none to equal it, the price being now a little more than that of Scotch fir. I planted a considerable number of it on a piece of ground, called from its bare aspect, "The Heather Muir," and which a few years ago was covered with heath. The soil, as may well be conceived, was not of the best description for trees. Its surface was composed of that thin light sandy soil common to heath tracts, and having a subsoil of a stiff, hard clay. Along with these were planted spruce, Scotch fir, and larch; and although many of these were injured, and numbers entirely destroyed by hares and rabbits, with which the place abounds, none of the Corsican pine were injured. This of itself is no small recommendation. They shew, too, every symptom of vigorous and sustained growth, are outstripping the others in size, are cleaner in the stem than the Scotch fir, are altogether free of the insect commonly called aphis, have none of those ulcerated wounds so common to the larch, and even during this rather trying season (1868) many of them grew upwards of 18 inches, while their neighbours, the Scotch fir, &c., have made on an average only 14 inches. Judging from the appearance of the largest specimen here, its handsome pyramidal form, its regular branches in distant whorls (caused by its rapid growth), and rich foliage, I can well conceive its magnificence in its native forests; where it attains a height of sometimes 130 feet in 70 or 80 years; and clothing the mountain ranges bordering the Mediterranean Sea, it adds materially to the natural beauty of the landscape, and the wealth of its native country. Its wood is of a whitish colour, with a darkish tinge of brown near the centre, is rather long grained, pliant, easily worked, very resinous, and durable. From its more rapid growth, and larger dimensions when full grown, it will produce more timber in a given period than the Scotch fir, and, therefore, even when viewed merely in the light of an economical question, it is well worthy of general cultivation. From my experience and observation of it, I think it is not very particular as to soil or situation, but will thrive almost anywhere, except on chalky formations—a condition unknown to Scotland—and on lands heavily surcharged with moisture; although, like the rest of the pine tribe it prefers a rich sandy loam, or a soil consisting of decomposed primary rocks, especially granite, with a cool dry subsoil in all cases. Of course, being a pine, it

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does not require a very deep soil, as it is a surface rooting tree. It would form an excellent substitute or successor to the Scotch fir, especially since the real Braemar variety is being gradually supplanted by a spurious coarse one not worth growing, and of which it will be difficult to get rid; while the price of seedlings, especially, is exceedingly moderate, being from 10s. to 15s. per 1000. When planted along with hardwood trees it forms an excellent shelter to them, because of its rapid growth and luxuriant foliage, its leaves being from 4 to 6 inches long, springing generally in pairs, though threes are very frequent, from a short sheath; while its rich green hue and general beauty adds materially to the appearance of the forest, &c.

From the personal culture, and from observation elsewhere, I heartily recommend the introduction of this pine into our pleasure-grounds, lawns, and general plantations, feeling perfectly assured that, both as a hardy ornamental tree, and a producer of good, durable, and workable timber, it has few equals in the numerous class to which it belongs.

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VIII.—*ON THE MOST ECONOMIC USES TO WHICH CHIPS, BRANCHES, AND ROOTS OF TREES MAY BE APPLIED.*

BY JAMES JOHNSTON, WEST VALLEYFIELD, CULROSS.

THERE can be no doubt that economy in all ages has been studied, and to some extent practised, but it will be admitted that the command, "Gather up the fragments that nothing be lost," has never been more strictly obeyed than in our own present and enlightened time.

It has long ago ceased to be a wonder to hear of and see the dust that is swept from the streets of our cities collected and made into bricks; also, the sewage from those cities, conveyed scores of miles to rural districts, or barren sands, vacated by the changeful ocean, and by its agency converted into fertile plains, producing food for man and for beast. The most obnoxious refuse is collected from our slaughter-houses, and converted into valuable manures, and applied as agents in agriculture. The farmers' pest, twitch grass, is collected, and made into paper. The rag merchants realize fortunes from the thrifty housewife's economy bag. He separates his heterogeneous collection, and disposes of it at handsome profits. To the paper-maker he deals out his share of the convertibles; to the bottle maker his; to the bone merchant his; and last, but not least, the tweed manufacturer his share of semi-rotten fabrics of clothing, that once kept us warm and comfortable amid winter's frosts and snows, to be again converted into warranted fast tweeds, from the finest wool! These, and innumerable other things of comparatively little value, are daily converted into useful commodities, and applied to economic purposes.

Notwithstanding the enormous amount of arboricultural produce annually consumed in various ways, there yet remains considerable portions of such produce, either lost or unprofitably employed, comprising chips, branches, roots, as the residue of thinnings of plantations, clearing of matured crops, or the reclaiming of woodlands; these and others the economist has either hitherto neglected or failed to discover any qualities in them sufficient to recommend them for economical purposes. The writer does not presume to possess the inventive genius necessary to solve the question, or hold out to those interested the hope that he can devise any means or point out any source of universal consumpt or economic application; but, from his experience in districts where everything in the form of arboricultural produce has not only been economically applied, but is intimately acquainted with persons who have risen from humble life to ostensible positions and wealth, from trading in what we call refuse of woods and plantations. Any knowledge possessed by the writer on the subject, he thinks, would be best conveyed and rendered most acceptable to those interested, if submitted in the form of a report, embracing the operations carried on in the forest where he acquired his experience.

B— P— the property of his Grace the Duke of B— is situated in the county of N—, parish of Th—, distant from a railway 4 to 8 miles, from water carriage 3 to 6 miles. Comprised within an area of 12 miles are three towns and a few populous villages, which contributed in no small degree to the consumpt of the produce in question. In 1859, when the writer entered upon his charge, the forest referred to contained 900 acres under a crop of coppice and timber, which was termed the coppice forest, and comprised every description of the deciduous class of timber trees. Under the timber grew coppice of every description, known as coppice plants, also 200 acres of plantations, chiefly mixed hardwood and larch, the latter predominant, and from three to forty-five years of age—in all, 1001

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acres of wood in one mass, divided into eighteen sections, varying from forty-five to sixty acres each. Now it must be borne in mind, that there are three distinct crops mentioned here, namely, coppice, timber, and plantations. To be still more plain and easily understood, I will give the particulars of each separately and consecutively.

Coppice, which was the first clearing for the season, was cut, and disposed of in lots of twenty poles each. It was sold by public sale in the month of December, and stipulated to be all cleared off by April, for the sake of the oak timber which was afterwards to be cut. The coppice fall averaged 50 acres per annum; from age, thinness of stools, coarseness of quality, there was consequently a great amount of refuse fell from it. Immediately after the sale, the woodmerchants, who were the principal purchasers, overhauled their lots, and selected all the produce adapted to their special trades, then disposed of the refuse to the faggot merchants, who cleared the land as they went. What was fit for pea boughs and bean stakes was dressed, and tied into bundles (with withes made from small clean rods) 4 feet in circumference, and laid into lots of fifty each. The remainder were tied into faggots, also 4 feet in circumference, and 4 feet long, and laid also in lots. The average cost of making was 4s. per hundred; value in the wood, 10s. per hundred; purchase and making generally amounted to 6s. 6d. per hundred, leaving a balance or profit of 3s. 6d. A considerable quantity of this refuse is disposed of to farmers and bakers, who cart it home themselves for heating their ovens with, preferring it to coal as being cleaner and cheaper; but the faggot merchant, who keeps horses of his own for the trade, preferred the hawking of this refuse to the towns and villages, disposing of it at 4s. 6d. per score; pea and bean stakes, 3d. per bundle. He then loads coal put up in bags, and hawks that on his homeward journey, or disposes of it the next day at home, and loads faggots again for town; others again who do not trade in coal, contract for stone carting for roads near to their round, and in this way carry on a brisk trade, earning a good livelihood for themselves. By these means considerable sums are realized for refuse that would, to a great extent, remain upon the ground worse than useless.

Considerable orders for faggots were executed in this forest, and consigned by water carriage 31 miles to Lynn Regis in Norfolk, for the reclamation of land from the sea; they had to be made from smooth wood (no thorns) 6 feet long, 12 inches in circumference, tied tightly with withes 18 inches from each end; average cost of purchase and making 30s.; total cost per thousand delivered at Lynn Regis, 50s. They were pegged down in layers on the sands at low water, the returning tide covering them in time with various sorts of deposit, which eventually was converted into valuable land.

Faggots, also, by the million, went to railways that were being made in the marshes of L—— and C——, for foundations for the embankments and roadway in general; purchase and making averaged 9s. per hundred, being made of all sorts of rough refuse, and tied without dressing. To these purposes was the chief part of 600 acres of coppice, varying from three to sixteen years of age, applied; and reckoning from the demand keeping steady, we must conclude that such refuse answered the purpose, and was economically applied.

The cut of oak timber, which averaged yearly 10,000 cubic feet, followed the coppice cut, the chief part of which was cut with the axe; consequently, a great quantity of chips fell from it, which were collected into heaps at the root of each tree after it was cut, and left there for the present. After the removal of the bark the dressing of the timber commenced, the chips and short pieces of wood that fell from it were, together with the felling chips, collected into heaps with a large skip, four of which made a cart-load, and valued in the wood at 5s. per heap. The chief part of this refuse was purchased by farmers and trades people, and stored past for winter fuel. After the timber merchants had overhauled the tops, taken out fencing-posts, and crooks for boat-building, they then sold the remainder to the faggot merchants, who tied them into faggots, and disposed of them

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much in the same way, and for similar purposes, as the coppice refuse. In this instance they had 6d. per hundred to pay for withes, which, with purchase and making, stood them on the average 10s. per hundred; value in the wood 14s., but at public sales we have seen them realize 24s. per hundred. In July we had from three to four hundred lime and poplar trees to cut, for the spoon and toy trades which were carried on near to the forest. The refuse of those trees was the worst to dispose of. We had to turn faggot merchants ourselves, and sell them to farmers for forming stack bottoms. After they served that purpose, they were used for oven fuel. This sort of refuse seldom realised any more than 8s. per hundred. In December we commenced cutting the ash, elm, beech, sycamore, maple, service, and chestnut timber, which averaged yearly 6000 cubic feet. The chips and branches were prepared in the same manner as the oak, and disposed of for similar purposes; cost of making, the same as others; value in the wood 12s. per hundred. Every season we had a portion of mixed hardwood plantation to thin. The refuse (prunings) of larch and hardwood mixed made excellent faggots for bakers, and was readily sold at 8s. per hundred.

The last timber sale that we prepared and conducted (Feb. 1866) was chiefly hedgerow timber. The topwood, being remarkably heavy, produced 17,000 faggots, which we made ourselves; also collected the chips, and sold all by public auction. Being near to good roads, the faggots realised on the average 16s. per hundred, chips 7s. per heap.

A great competition was carried on between the faggot merchants and the charcoal burners, who bought extensively of the topwood of deciduous trees, trimming off all the branches down to 1 inch in diameter, and stacking them in convenient places for charring in the forest. The twigs were generally given to the faggoters, who worked them in along with heavier refuse.

The continued practice of felling the coppice and thinning the timber crop every 16 years, had so reduced the standard crop of the forest, that in 1862 his grace's agents considered it necessary either to replant or reclaim it for cultivation. It was decided to reclaim 600 acres, and replant the 100 lying next to the previous-mentioned plantation part, which would still form a forest of 500 acres. We accordingly received orders to make arrangements for reclaiming 100 acres per annum, taking 50 acres of young coppice and 50 acres of matured coppice each year. It would be out of our province to introduce here any particulars save those relating to the subject—namely, the application of the roots, &c., which fell from the grubbing or reclaiming of the woodlands. The purposes to which they were applied, and the methods of application, we consider essential. Let it suffice to say, that on the 29th July 1862, the first sod was turned for the demolition of a forest that had at one time formed part of R—— Forest, where the deer had for ages roamed at their liberty, disturbed only by the sportsman perched aloft in the buck-headed trees, formed for the purpose of watching his game, and where the Roman warriors had rested, fed their flocks, and pursued their industries, evidences of which were found, such as spears, bells that had fallen from the necks of cattle, and ovens for burning pottery. After we had the first section of 50 acres grubbed, the quantity of roots was fearful to look upon. From the root that had produced 150 cubic feet of timber to that of the hazel, the land was literally covered. A considerable quantity of the small roots was sold at 12s. per waggon-load (about 2 tons), but the supply quite overran the demand in this instance; we, of course, required a portion of small roots to burn the large ones with, which was the cheapest mode of disposing of them, and which we took advantage of, and burned large quantities of earth or turf as it was turned over with the spade. This mixture of wood ashes and burned earth was spread upon the land before the seed-sower, and harrowed in along with the seed, which resulted most profitably. The crops that had a liberal dressing averaged fully 15s. per acre more at the public sales. Seeing that draining would have to be carried out extensively, and the cartage of tiles from a distance would aug-

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ment the expenses very much, we conceived the scheme of burning bricks and tiles with wood. After a trial, which resulted satisfactorily, we erected a wooden shed to accommodate a portable steam-engine, a pug mill with rollers and dies attached, also a circular saw table, placing them so for the engine to work both simultaneously. The purpose of the saw was to cut up fencing for enclosing purposes, also waste wood to supply the engine in place of coal. The kiln, together with brickfield indispensables, was erected, but only in a temporary way, in order to finish the undertaking.

A short description of a kiln heated with wood instead of coal may be acceptable. We would recommend a 20,000-kiln—*i.e.*, a kiln constructed to hold that quantity of bricks. When this size is not sufficiently large, two had better be made. The fierceness with which wood burns necessitates the sinking of the kiln at least 8 feet below the surface of the ground. This is required to modify the draught, which is the primary point in a wood-burning kiln. A kiln of this size requires three fire-holes, open on one side only, but passing through the whole width of the kiln. To give facility for charging the fires, the holes should not be less than 36 inches high by 24 inches wide. They should be carried out 7 feet from the side of the kiln, the top of their arches loaded with clay, and buttressed against the side of the kiln. This extension is necessary to prevent the flame from passing through the flues, and coming in contact with the ware in the kiln. The flues require to be smaller and more intricate than those of coal-burning kilns, for the same purpose of sheltering the ware, modifying the draught, and distributing the heat in a regular manner.

The process of drying the ware in the kiln, preparatory to burning, must be performed with great caution. The unsteadiness with which wood burns presents a difficulty of maintaining a uniform but increasing degree of heat, to bring the ware to that state to stand the volume of burning heat. That state is indicated by the decrease of steam evaporating from the ware, which gradually assumes the colour of smoke. As soon as this becomes manifest, the burning process may be commenced. The wood for the drying process should be thoroughly dry, otherwise it is apt to convey moisture into the ware, cause a lingering process, and deteriorated ware. The roots of the ash, elm, maple, and hazel are well adapted for this purpose. They contain very little moisture, and a much steadier heat can be conveyed from them. After the drying process is completed, any other sort of wood may be used that can be put into the holes; all sorts of branches made into small faggots, about 18 inches diameter, answer very well for burning 2-inch draining tiles. All ware of heavier make requires stronger wood, applied either by itself or along with faggots. In stoking the fires, there should always be a supply of large roots at hand to roll into the mouth of the holes after charging them. This restrains the draught, and serves the purpose of making the roots less, so as they can be pushed further in at the next charge; and they likewise generate a strong and steady heat, almost equal to coal. It is also necessary to have pieces of sheet iron to hang on the mouth of the holes to prevent the escape of heat. It will require about twenty hours continuous burning to attain the essential heat; but this, in some cases, may be only an approximation, for all clays will not stand the same degree of heat, therefore do not require the same time; but this time is indicated by a white heat, which is the highest attainable degree, and which this clay required to produce good sound ware.

It will also be necessary to give a statement of the cost of applying this refuse to the purpose above mentioned; and, in doing so, it will be well to place the cost of applying coal against that of wood. It must be understood, however, that we put no commercial value upon the refuse, putting the clearing of the land, and any trifle that accrued from it, as its value; also that coal delivered in the forest would have cost 16s. per ton; also that the kiln being a 35,000 one, and much too large for burning with wood, a greater saving would have been effected with the size previ-

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ously mentioned; also that it required 10 tons of coal to burn 35,000 bricks in other kilns situated in the district.

WOOD.			
1500 faggots, making and carting	£2	12	6
40 cart-loads roots	2	0	0
Cost of application	2	0	0
35,000 ...	6	12	6
Cost per 1000	0	3	9¼

COAL.			
10 tons coal, 16/	8	0	0
Cost of application	1	0	0
35,000 ...	9	0	0
Cost per 1000	0	5	1½

The annual produce of the brick-fields averaged 140,000 draining tiles, and 100,000 building bricks, which were used for building farm steadings. The small balance of 1s. 4d. per 1000 in favour of the wood, together with 3s. per acre saved in the clearing of the land, was considered sufficient to warrant the application of such refuse to that purpose, but it would have resulted much more profitably with two 22,000-kilns instead of a 35,000 one.

Branches, roots, and chips, we have seen applied to the burning of clay into material for roads, garden walks, court-yards, or, in fact, any purpose that stone in a broken state is applied to; but, of course, it is not so durable. In clay districts, where stone cannot be obtained but at an enormous cost, it is a good substitute. In the summer of 1865 the writer passed over 30 miles of roads, newly formed, in the parish of G—— G——, county of N——, that were formed entirely of the above material. Stone in that locality being a scarce commodity, it is quite a common thing to see a well 100 feet deep dug in fine blue clay. Part of the above material was burned with coal, and part with plantation thinnings, and we could see no difference in the quality of the material, but with this exception, that there were more ashes in that which had been burnt with wood. The method of burning clay is much the same as burning limestone in open kilns—a layer of fuel and a layer of clay is placed alternately. It can be produced in that way from 7d. to 1s. per cubic yard. To make a good sound road, it should be screened, or bar shovels used to lift it with. To produce a first-class material, even preferable to some stone, we recommend the burning of clay in kilns such as are used to burn tiles or bricks; and in districts where clay is abundant and stone scarce, and wood of any description considered valueless at hand, the cost of building a kiln is a trifle compared with the cost of getting stone, or the loss incurred by having bad roads. The screenings or ashes falling from this material are valuable for applying to nurseries or gardens situated on wet clayey soils.

We will draw these brief remarks to a close by placing in contrast the sources of consumpt for these sorts of refuse peculiar to Scotland with those of England. The great bulk of refuse falling from arboricultural produce in Scotland is of that nature (the pine tribe) that it would not meet with such ready and profitable sales in England; yet it would all be consumed, and its value obtained. Assuming, however, that the refuse in Scotland was wholly that of deciduous trees, it would have little effect upon the consumpt in bringing it to a par with that of England. To make this more clear, it will be necessary to make a few statements as to the sources of consumpt. The steady, and we may say unlimited, demand for this refuse in England proceeds chiefly from the householders' demand for fuel. Some may be induced to say, that fuel is as necessary to, and is consumed in Scotland, as well as England. This we admit; but it must be borne in mind that the population of England is much greater than that of Scotland; also, that the customs of the one country are very different from the other, which is the chief cause of the universal consumpt. The population of England is congregated more into villages and towns; the agriculturist does not enjoy the privilege of having accommodation on his farm for his servants; he does not engage them for his work on the same terms as agri-

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culturists do in Scotland. The English farm labourer receives his wages in monthly, fortnightly, or weekly payments in money. He has a house to find for himself in some village contiguous to the farm he is employed upon. He does not enjoy the privilege of his northern brethern, of having a house and fuel found him as part of his wages; but is obliged to purchase everything that goes into his house at, what we may say, exorbitant prices. The faggot and coal merchant is as essential to him as the butcher or baker; and the threepenny faggot and shilling bag of coal must be reckoned in the week's supply of household essentials. Enormous quantities of faggots and chips are consumed in towns by well-paid artisans and tradespeople. We see no difficulty in organising and carrying out the same system with similar results in Scotland, more especially upon estates lying near to large towns, and we are fully convinced that the system would be most acceptable and appreciated by the inhabitants of those towns, and, at the same time, clear plantations of refuse otherwise generating disease, and a temptation to people to trespass in woods, which is a most unbearable nuisance.

In every county in England where we have had the opportunity of getting any knowledge upon the subject, the faggot trade was the same, and similar prices realised; but it would be a fruitless attempt to try to dispose of loose branches, either at public sales or by private bargain to private consumers. The only plan of getting rid of such refuse is, either to dispose of it loose and wholesale to the faggot merchants, or have it made up and retail the faggots, which is the most profitable. In many instances, the profit realized defrays the cost of cutting the timber, and, wherever carried on, on either plan, a book should be kept exclusively for it to enter all particulars therein.

We have in various places in this report digressed widely from the subject in question, but this digression was mainly to point out where such refuse fell from, also the quantity of it, method of preparing it for sale, the source of consumpt, and manner of disposing of it, or applying it to any of the purposes mentioned, in which we have had sufficient experience to be able to testify that the application of such refuse to those purposes can be successfully carried out, and also that it is economical.

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IX.—*ON THE BEST MEANS OF INCREASING THE COMFORTS AND OF IMPROVING THE SOCIAL AND MORAL CONDITION OF UNDER-FORESTERS AND APPRENTICES ON LARGE ESTATES.*

BY CHRISTOPHER YOUNG MICHIL, FORESTER, CULLEN HOUSE.

IT would be difficult to over-estimate the claims and importance of the above subject.

Neither logic nor mathematics are necessary to prove the intimate and inseparable connexion which subsists between a duly qualified or disqualified forester, and good or bad forestry. Even those who lay no claim to abstract reasoning soon arrive without difficulty at the settled conclusion that, wherever forestry is skilfully and judiciously executed, it is only so done where a duly qualified forester is in charge. A person passing rapidly through a country by railway, whose eye is accustomed to observation, and whose mind is imbued with the true spirit of forestry, can very well determine as to the competency or otherwise of the forester in charge of the wooded estates passed through. Of all the external mediums or senses through which our impressions are conveyed, the eye is the safest and most to be relied upon; how often are the most shrewd and observing of men misled and deceived on engaging their servants by misjudging their qualifications.

Having only spoken with a man, scrutinised his autograph, the master is satisfied with and engages him, but soon finds by experience that he is far deficient of what he anticipates. Such common but unpleasant results are neither the fruits of wilful deception on the one hand or want of penetration or discrimination on the other, but simply that the tests are imperfect and too superficial to reveal the true man, and make known those necessary and essential facts as to whether the man is a mere gifted speaker and elegant writer, or practical in the other and more important respects.

Though elocution and penmanship are gifts of no mean order in their way, especially in literary appointments, yet they occupy only an inferior and subordinate place in forestry; hence the person chosen upon one or both of these points of merit may be literally disqualified for the general duties of forestry. As qualification tests for foresters may, however, be made the subject of a separate essay, nothing further need be advanced respecting it here. Before enumerating the qualifications necessary for a first-class forester, it may be well to look into the nature of the duties he is called upon to perform in the line of his profession.

The duties of a forester, abstractly considered, may be presumed to consist in the art and practice of growing forest trees. The culture of forest trees is a subject amply sufficient to occupy and engage all the time and talents of the most gifted and energetic men of the age whose span is limited to "three score and ten," without distracting or dividing his attention with other matters. Where men have excelled in any science or profession, it has invariably been where they have steadily and perseveringly pursued one branch of it; and it is evidently a true fulfilling of the common proverb, "Jack of all trades and master of none," that the low tone of forestry is what it is, as seen in our poor but neglected plantations at the present time. The duties of the forester probably ought to begin with the seed or seedling, and end with the cutting down and sale of the timber crop, embracing all the operations intervening between these extreme points. We have heard a respectable forester say that his greatest ambition and pleasure lay in cutting down fine timber trees. With all due respect to such ambition and pleasure, we must say that ours differ in the opposite extreme from his. Few breeders, or even feeders of stock, would admit that the

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slaughtering and dissection of their cattle were their greatest pleasure and delight. It is yet in the memory of some men living that a carpenter was considered a skilled forester who could select and cut down the trees most suitable for his purpose and trade. It is also fresh in our own memory that a man stood high in his calling as a forester who could dexterously impound sheep or cattle, or frighten a country schoolboy in quest of his favourite bow and arrow, bullet gun, or whistle wood. We have happily outlived these good old times, and raised a standard higher than that of our forefathers; yet there is much to do. Untrodden paths are yet to traverse, and heights to ascend, before we reach the goal of human perfection, which term signifies as high as the scale of manly perfection will allow him to arise.

The first thing required of this paper is to shew the best means of increasing the comforts of young men as foresters on large estates. The suggestion of the requirement, in the first place, presupposes that their comforts are, to some extent, incomplete and defective; hence that certain aids and supplements are required to meet them. To lay down an abstract rule, or erect a model standard of what true comforts are, would involve endless difficulties, increase bitter dissensions, and multiply serious objections *ad infinitum;* and the writer would, in all probability, leave the subject more vague and unsettled than when he first began. Believing that a faithful account of what several eminent and now first-class foresters have undergone, who once occupied the position of apprentices, and wrought upon large estates, together with an embodied experience of the writer's, will be found a great auxiliary, if not the desideratum, under this head.

First, we may look at the term and condition upon which apprentices should be engaged; second, at the age at which they should enter the duties of their apprenticeship; third, how their time should be employed during the term of engagement; fourth, the obligations of the apprentice to his master; fifth, the obligations of the master to the apprentice; sixth, shew some of the objections to the present mode of granting certificates of character; seventh, the wages and means of support necessary for the comforts of a young man. 'First, the terms of an engagement should be three years, and made without any formal or legal form of writ. The writer's personal experience is against all such written agreements. The following are amongst his reasons of objection to them:—A lad of an amiable disposition, and easily led or influenced by others less well-disposed, is easily made to believe that his duties are too arduous or irksome, and that he is generally worse treated than his predecessors were, or than he himself deserves. In such cases he is further advised critically to examine the letter of the *written term of agreement*, and by doing so he would, as a natural result, be led to construe certain clauses and unduly emphasise others; thus quarrels and disputes would arise as the inevitable consequences. So that paper agreements between masters and servants are too flimsy and tender to be relied upon in binding them together, and more frequently form bones of contention and strife, and not unfrequently lead to litigation and other evils. We have heard youths speak of *civil law*, *police acts*, *&c.*, in such a manner as if they regarded them as the true and only standard of right and wrong. If their views of law chanced to be right, they might also be so far right; but if their notions of law were wrong, which is more likely, they would equally and conscientiously do what was wrong just because it was law. The extreme opposite of this course is that which the writer would recommend. Written terms he has no objections to, as such, but only objects to them on the grounds above stated, believing them to be only valuable as statements relative to wages, times of payment, term of engagement, and such like. An apprentice forester's agreement should not assume the character of an indenture, but simply constitute a memorandum that each party may be enabled to recall his obligations to the other. The terms, however, whether verbal or written, should be plain and commonplace, and divested of legal terms

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and phrases. All are the better of being reminded of their duty at times, but should never be led to discharge it as a legal obligation, or because certain clauses inculcate it. On the estate of F——, where the writer served his apprenticeship, the agreement was only a verbal one, and fully met all the requirements of the case. The wages named were for the first year 9s., for the second 10s., and for the third 11s.; the general workmen on the estate at the time had 11s. per week. In addition to the weekly wage (upstanding), £1 extra was allowed for the harvest month. The usual workmen upon the estate were either allowed absence of one month for the harvest or £1 additional monthly wages. The apprentice who was also retained from the harvest generally devoted his time during that month to pruning. This was found both a good time and opportunity for pruning operations, for unless such work had been thus overtaken the probability is that it would not have been done at all, and the trees would thus have materially suffered for want of it.

At the expiration of three years, the specified time of agreement, the apprentice was allowed about four months to go to a public nursery in order to gain further experience and practice in the culture of plants and nursery work generally. At the expiry of the four months, more or less, he again returned to his former occupation and employment, and now took his turn at the ordinary work along with the other workmen. The more difficult departments were, however, more frequently allotted to him, such as certain kinds of nursery work, pruning, erection of palings, hedge cutting, &c. A junior apprentice being generally engaged shortly after the senior one left for the public nurseries referred to, and at his return the junior apprentice accompanied him generally at most works, who was privately instructed by the master to impart all the information to him he possibly could. By this means the young apprentice got early initiated both into the art and practice of many branches of forestry, and thus escaped a very general evil—that of first being allowed to do things wrong, and afterwards having to undergo the ordeal of doing them right. In this capacity the journeyman remained a longer or shorter period, seldom less than three years, at the expiry of which he was considered fit to take a foreman's place, and in some cases even a situation of higher trust and charge. At the end of six years, when the journeyman continued further to remain and fill the situation of foreman, he had from 2s. to 3s. per week more wages than the general workmen. As foremen, they usually continued two years, when they sought other situations in order to promote their social condition and gain experience. Having by this time fully demonstrated many traits of their disposition, the master was enabled to furnish them with certificates of character, &c., setting forth their steadiness, truthfulness, honesty, industry, perseverance, ingenuity, and all with considerable confidence as to their verity; and having earned an important certificate, and one that would either do him much good or harm in after-life, according to its merits, which the master faithfully and fully supplied according to the solemn terms of moral obligation, which means stating the truth, the whole of it, and nothing but what is true. The foreman now, thus furnished, looks out for a change of situation, and obtains one only as a workman upon an estate of considerable extent, under a forester of known ability. It is better to go as a common workman at first, and if he remains over one year he might be eligible for a foreman's place. If, however, such is not vacant, he may continue to remain a little longer. High wages or power ought only to be secondary considerations compared with that of acquiring experience, which must be procured even at the sacrifice of comfort. Pecuniary matters ought not to weigh too heavily in the scale against experience and proper instructions.

The age at which an apprentice should enter upon duty will depend to a considerable extent upon his physical strength, having to enter upon rough toilsome labour, and often to perform long fatiguing journeys, as the work of foresters generally lies detached and wide

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apart; also, that his labours may not be felt oppressive, he requires considerable muscular strength and agility. The money wages, too, must be adequate, and sufficient to support and maintain him, if guided by frugality and strict economy.

Seventeen or eighteen years of age appears a very proper time for engaging an apprentice, as shewn by these, and other reasons, which will appear in the sequel. The way in which an apprentice should spend his leisure time is a matter of paramount importance, and it is in reference to this more than any other circumstance that the master has to exercise judicious authority and due command.

Many rules might be laid down, and all of them good, but in this, as in other prescriptions, they would likely all differ and shew each their respective points of weakness and defects. We have thought the best means of enabling a young person to husband his time is, to induce him to lay down what may be called a working plan for the complete engagement and occupying of it. To shew that this proposition is not singular, new, nor entirely of the writer's own conception, he subjoins the following lines of the immortal Pope, who says—

> "Without a plan my moments run to waste,
> Wild are my wishes, wanton is my taste;
> Without a plan mere inclination rules—
> The fluctuating quality of fools;
> Without a plan the understanding sleeps,
> The memory's loaded, and the judgment weeps."

We would recommend two sets of rules for the spending and employment of time: one for the summer months and another for winter. As we regard the observance of these rules as a great means of a young man getting on in the world, we subjoin them at further length. First:—'Rules for summer'—Rise as the clock strikes five, if work is resumed at six, and at six if resumed an hour later; this rule is subject to gradual variations as the days lengthen or decrease. As an extraneous or supplementary means of fortifying and strengthening the resolutions of a young man for punctual rising, especially in cold weather in winter, we would recommend him, on awaking, to *inhale* his breath to the full extent, at the same time firmly resolving not to *exhale* it till he does so out of bed, with his feet upon the floor. This may appear to those of iron resolution, such as the late Duke of Wellington, bad advice, entirely uncalled for, and applicable only to the supine and effeminate. Our own experience, however, goes to prove that not only is such advice sometimes called for, but essentially necessary and worthy of a trial. The practice of lying too late in bed is both a general, pernicious, and hurtful habit, and one, by-the-bye, which, when fairly rooted, it is difficult to extirpate. From this evil a thousand others spring, all of them bad and productive of evil. Slumbering in bed is different form genuine sleep, eight hours being amply sufficient for the latter requirement. The late Duke of Wellington remarked to a friend, when asked how he managed to turn himself in his bed, which was so narrow, replied, "I never turn, except to turn out." It is quite evident that rising in due time, and performing certain duties deliberately in the morning, is an essential means to a young man's improvement, both mentally and physically, as much so as the winding up of a watch is to its keeping proper time, or a person taking food sufficient to sustain life. This rule ought to be strictly enforced by all possible means, and at all costs. It is not enough to rise fifteen or twenty minutes before leaving the house for work, which necessitates hurry and bustle; hence the improper doing and forgetting of things. Anything hurriedly done is always badly done. Diet is a matter of no small importance; sufficient time is also required for this. Porridge ought to be the breakfast of a young lad, or at least constitute the staple part of it. Scotia's sons may yet live to repent having forsaken this noble dish. If well boiled, of proper consistency, and sufficiently cold, it may be supped in less than ten minutes. Porridge is by far the most nutritious and wholesome food that can be taken. After breakfast, as after all other meals, a rest of at least ten minutes should be taken, and at least other ten should be employed in reading some subject worthy of reflection during the day. Another very important duty, and well befitting either young men or old, is to breathe a

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short prayer of gratitude to Divine Providence for the night's rest and joys of the morning. Altogether, an hour is required between the time of rising and that of leaving the house, thus entailing the importance not only of early rising but of punctuality also.

On arriving at the place of work, the duties of the day should be resumed with earnest "aident hand" and diligence, and according as the weather is, so ought the working garments to be adopted. A good working man always shews freedom in his dress, and nothing pleases him better than when he can get (as he terms it) "fairly stripped out." In well-regulated works we prefer an arrangement for a rest of ten minutes at ten o'clock in the forenoon, and again other ten in the afternoon. This is expressly desirable, especially where youths are employed; and we would modestly suggest to those in charge of large companies composed of both sexes judiciously to consider this. The ten minutes is locally known as "the smoking time," and though all do not engage in that luxury, yet all enjoy a few minutes' rest. Man, though a moving, working being, is not a machine of iron or brass, alike incapable of enjoying and unconscious of requiring rest; and, as a rule, those who require no rest are such as deserve none, because they do not rest till tired enough to require it. When the dinner hour arrives, and after partaking of the frugal meal, care should be taken not to lie down prostrate upon the back, but either to sit erect or lie upon the side. In eating, there are two primary rules to be observed: the one is not to overeat, and the other is to masticate well that which is eaten. A very common but hurtful practice in eating is to fill the mouth with dry bread, and then to fill it with liquid to wash it down. The ultimate results of this practice of eating is a diseased stomach, which soon affects both body and mind. We cannot too highly inculcate the necessity of proper mastication of the food, in order to maintain a healthy organization of the body, upon which all other acts, mental or physical, either directly or remotely depend. It is a serious matter for a young man, through ignorance of the laws which regulate his health, thereby to contract diseases, such as toothache, rheumatism, or dyspepsia, which is often done through the neglect of guardians and others intrusted with youths, in withholding from them the necessary information upon which their future usefulness and happiness depend.

During about three quarters of the year, one hour is taken at dinner time; one quarter of it is employed in eating, and fifteen to twenty minutes are required for assimilating the food; the remaining part of the hour should be occupied in committing to memory a portion of the subject which the young man is studying at the time. If it is Botany, he may commit to memory ten English and Latin names of plants, which, in a year of working days numbering 313, is by no means a small or unimportant vocabulary to begin with. By this means a lad will, in a short time, with due application and diligence, acquire the names of all plants he may come in contact with. Those half-hours, if well occupied, can accomplish great things, but if badly husbanded, may prove an amount and source of power for great evil. On leaving off work for the day, and on arrival at home, the first thing to do is to wash and dress before sitting down to eat. There is a strong temptation on the part of most young men to violate this rule, especially if in lodgings and sitting at table alone. In speaking of dress for a young lad, who has only from 10s. to 12s. a-week to live upon, it must be understood, in a very restricted and qualified sense, to signify generally only a change of the outer garments, including that of shoes and stockings. Who that has the smallest sense of self-respect, and can appreciate cleanliness and comfort, but would concur in the observance of these duties. Tea is now very commonly the evening meal, and is both a cheering and refreshing one. Respecting the properties of tea, however, as of most other things, there is great diversity of opinion, not only as to what constitutes the essential qualities of it, but also in respect of its virtues and the *modus operandi* necessary in infusing it. Without presuming too much, we would humbly tender a few remarks upon tea. In the first place, it ought to be regarded as a stimulant rather than as a strength-producer. There are two essential

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properties in tea—the one is theine, which *alone is tea* in the true and proper sense; this contains the aroma and flavour, which is extracted from the leaf by submission to hot water for about five minutes; the other ingredient is *tan*, a substance similar to that contained in oak bark employed in tanning leather. In respect to the latter ingredient, there often results considerable mischief by allowing it to be too much extracted from the leaf by protracted infusion and high temperature of the water. This process makes the tea dark coloured and strong tasted. This colour and taste is regarded by some as the excellence of tea, while those better informed reject it as unwholesome, knowing that it is not tea, but tan, they are invited to drink.

Every apprentice should be obliged to keep a diary, and to shew it to his master once a week, or at any other time when requested to do so. The master examines it, and appends his initials to the part last examined, at same time noting on the margin all errata he may have discovered. The diary should be a plain ruled book, 14 inches by 9, with each folio divided transversely into three divisions with red lines, one for each day. Diaries fully prepared, by dates and headings, do not answer well for general use, as the necessary entries for each day vary considerably, both in length and importance. One day's entries are frequently twice as long as others are; hence the inconvenience of fully prepared diaries. In commencing the diary, two or three folios should be reserved to form an index to all the principal entries. The subjects entered in the diary daily should embrace, amongst others, the following subjects:—What description of work employed at, as planting Hill of Doon; thinning Glenbank; draining Boggy Hill. The weather should also be described, stating the temperature, and points of the wind at six in the morning, and the same at seven in the evening; the manner in which the work was performed, the object in doing it, and the true or probable cost. The valuable results of keeping a diary cannot, to a young man, be overestimated. We would further state that the diary referred to becomes, when filled up, the property of the master. This necessitates the apprentice to make a duplicate of it; and, in addition to the matter referred to, much other matter should be added of a strictly private nature, and neither the master nor anyone should on any account ask to look into it; and which, if asked, should be sternly refused, as such interference might tend to prevent a full, true, and unreserved account being written in future. In addition to the diary, another book is highly necessary, and one which every young man should keep—viz., a note-book of correspondence.

This is simply and easily done in the following form:—

1868, Jan. 10th. No. 1. William Smith, Aberdeen; inquiry about ——

Jan. 11th. No. 2. Brother William; domestic matters.

Jan. 12th. No. 3. James Bennet, Inverness; answer about oak timber.

For this purpose a 1s. memorandum book answers well; each entry extends across the the two pages confronting each other, and should be ruled with four double lines upon the margin, on the left-hand folio. In reference to apprentices whose correspondence is chiefly social, and not yet having to do with business letters connected with the estate, this book is also private, and the master should not request a sight of it, but may with propriety occasionally ask if it is regularly and correctly posted: this is by way of reminding him of his duty regarding it.

The above may occupy half-an-hour's writing each evening, and should be completely filled up before going to bed, by no means allowing it to lie over night, though the demands of repose might urge the latter claim. One great inducement to write the diary properly and correctly is, two or more lads each keeping a similar one, posted in the same manner. Each diary ought to be compared by the master with the others, to ascertain its correctness as to dates, and other known matters of fact. Each one is thereby brought to write correctly for the sake of the other, who will detect his errors. Upon the

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employment of the winter evenings depends, in most cases, the success or failure of a young man. Some who may read these pages can testify and corroborate the statement. Let no man, therefore, say he had no chance for improvement who has comparative quietude in his lodgings, the enjoyment of health, and light to burn. If he fail, the fault is his own; with similar advantages, others have succeeded. The winter evenings may be employed as follows—say, writing diaries and other memoranda till seven o'clock; arithmetic till eight,; botany, chemistry, geology, or other science till nine; geography and grammar till ten; when further advanced, drawing may occupy the place of the latter; reading history till eleven o'clock.

Of course, the above form of rules is subject to considerable modification, and must vary as progress is gained; nor is it meant that every night of the week should be rigidly occupied as above prescribed. If in the vicinity of a town or village, various societies urge their respective claims; scientific lectures should be listened to, and various other meetings, such as debating societies, temperance societies, mechanics' institutes, reading-rooms, &c.; all of them call for a share of time and attention. The description of lodgings must also be taken into account in determining which of the prescribed duties should be commenced with in the evening, on account of noise and bustle, &c. The foregoing is an outline of the occupation of the six working days, and now one word about the Sunday, and how it ought to be spent; but before doing so, we would recommend that all sectarian principles be kept in the background. For our own part, we much prefer reading a man's creed in his principles and practice to that of hearing it verbally repeated. We consider it advisable, on engaging young men, to ask no questions as to church matters; if they are in error or ignorance, better example may put them right, and if already right, so much the better. The apprentice or young man should attend some place of worship, and he should also assist in some useful Sunday work, such as Sunday-school teaching. He should also attend some advanced Bible class for his own personal improvement. This is an excellent way of occupying time, and drawing out and developing what is within. Sabbath-school or other teaching of youth is a grand preliminary to dealings with men in after-life. It increases patience, strengthens the spirit of forbearance, and lays the foundation of many virtues, such as self-denial. The readings for Sundays, too, should be select, and different from those of other days of the week, in so far as the one is for spiritual or heavenly improvement, while the other is for moral or earthly improvement. We offer no apology for these remarks, believing them to be essentially necessary as articles in a young man's calendar for life, and as a precedent to true worth and greatness. Amongst others, we have read on Sundays with interest and benefit the following books, and can, therefore, with confidence recommend their perusal to young men. First, the Bible; "Philosophy of the Plan of Salvation," by an American citizen — a standard work; Barnes' "Notes on the New Testament;" Archbishop Paley's Theology; Josephus's "History of the Jews;" Keith's "Evidences of Prophecy;" Baxter's and Bunyan's writings; also M'Cheyne's "Memoirs;" the writings of John Angel James and Dr Winslow. There are also periodicals, fresh and new, and useful in their way, such as "The Sunday Magazine," by Dr Guthrie; "The Quiver," by Cassell; "Good Words," by Dr Norman M'Leod, and also Spurgeon's writings. These, and many others equally noteworthy, may be read with advantage. If these are carefully perused and duly reflected upon, the reader will be furnished with truths well calculated to store his mind with useful, substantial, and essential knowledge.

Having described some of the means whereby the moral condition of young men, as foresters, may be best promoted, we shall next advert to their social condition, and endeavour to shew how this can be best improved and advanced.

First, there must be sufficient allowance made them in the form of wages to meet all legitimate requirements, because young men

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at the age indicated should be able to support themselves without extraneous aid. If a lad have too low wages, he must either contract debt or remain in want of some of those necessaries of life essential to comfort and advancement. If, on the other hand, he is furnished with means more than sufficient to meet his necessities, luxuries begin to be indulged in, and extravagance, vanity, and folly soon follow. Here we would beg to tender one courteous word of advice to parents and guardians who are in charge of youths and apprentices, to let them feel in due time what self-reliance and self-support practically means. They should not lend an ear to craving letters or encourage the spirit of mendicancy, as by so doing they, in fact, propagate the spirit of meanness and dependence. To this, as to every other rule, there are exceptional cases, such as pure accidental losses, times of protracted sickness, or paying an occasional doctor's bill. Unless, however, under very peculiar circumstances, supplementary money should conscientiously and firmly be withheld. Habits of industry and frugality are lessons worthy of purchasing dearly, and are never better learned than when young, and during the years of apprenticeship.

Experience proves that the man who is careless over his own, is not likely to be careful over his master's property, and a want of carefulness may very properly be understood to mean wastefulness. Next to the means of life, comfortable lodgings are of vital importance. In the first place, a lodger must make up his mind to conform to the household rules and regulations, and never for a moment dream that because he pays his lodgings he is entitled to do as and what he pleases.

The hour for locking the door at night should be duly respected and attended to, and if it be requisite to be out later than usual, leave should be obtained to do so, and on returning home he should enter his dwelling gently and quietly, so as not to disturb the inmates of the house. His actings should be all open and manly, and never done in such a way as to provoke suspicion. All artifice and deception should be guarded against, and leave should never be asked on any account on false pretexts in order to accomplish an object. With the outward forms of domestic religion he should endeavour to conform, but he if cannot conscientiously do so, it is his duty to change his lodgings for others where he can so conform. We knew a young man who was in lodgings where the household rules forbade profanity; he refused to conform, left his lodgings, and went to seek them where he could swear. Another lad refused to doff his cap at table, and this also led to the change of his lodgings. Now, as the manner in which a lad conducts himself in his lodgings is a good index of what his private life is, it is the duty of the master to know well how it is spent. The most suitable lodgings generally are where the family is small, say two or three children, or where children have grown up and left the house. Another very desirable class of lodgings are those kept by a widow or elderly maiden lady. In the latter case, as many as four lads are sometimes kept; and where the woman is of sufficient command and authority, she can by this means conduct her house well, and find the means necessary to eke out her livelihood by washing, dressing, mending, &c. The above description of lodgings is an excellent substitute for bothies—meets all the requirements of the latter, while it avoids its serious disadvantages. So much has been spoken and written about bothies, that nothing seems further required to be said about them, save that where they do exist, they usually require more than ordinary skill to manage them. In bothies there is one important element awanting for social comfort which is generally present in respectable lodgings—viz., female society, without which the social scale must ever be defective and low. Briefly upon this head, comfortable lodgings, with a female attendant, proper household rules practically carried out, cleanliness, and quietude are all that can be done for the young man at this stage of his career. Having briefly noticed some of the means calculated to produce the best moral and social results, and shewn how the true comforts of life are to be secured, we may presume now to state what ought

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not to be regarded as comforts by young men; but more than a passing notice of these could not find space here.

Beginning with tobacco and snuff, these are to be eschewed, being only gratifications of the lower animal appetites; their use is a nuisance, and their abuse obnoxious to others, and hurtful to some degree to those who use them. How very unpleasant, on a balmy summer day, when the air is sweetly perfumed with the odour of flowers and foliage of the trees, on taking the pruning-knife, out of the hand of the operator to instruct him in its use, to find the blade clotted with tobacco, and positively offensive with the narcotic smell, producing feelings anything but pleasant to the uncorrupted olfactory nerve. The back of the knife, at same time, is often worn in an unsightly manner by its frequent application to the flint in lighting the pipe. Snuff has also its serious and degrading objections, and ought, for the same or similar reasons, to be guarded against, shunned, and avoided. Let not, therefore, the young forester call these ingredients comforts, as most masters would rather detract than add such to his stock.

Inebriating drinks are also pernicious and dangerous luxuries; and while the juice of the vine may enable the old man to eke out his gloaming of life, or fan the flickering spark when the fire of life burns low, yet the young man, fired with life, and already cheerful almost to mirth and frolic, as little requires artificial fire as the pot does whose contents are already boiling over. Let not, therefore, the young man dream of meeting with a master who would help him to seek such comforts.

Sofas and couches are also luxuries, but safe for the young man for whom we now write, who must only indulge in them as yet in prospective fancy. An apprentice, or young man further advanced, would, we presume, blush at being seen stretched like an invalid upon a couch or sofa, and by referring to his calendar, he will not find entry of it there. There is no time allotted for luxurious indulgence, and it is only in cases of dislocated limbs, deep cuts, or painful bruises, that the sofa is ever thought of being occupied; and even then, as far as practicable, books and other studies should be turned to account.

Some young men are of gross habits of life; hence they believe that real enjoyment and special comfort consists in eating. They consequently indulge, when opportunity affords, in delicate and savoury food, and find special delight in highly-seasoned dishes. It is well known that indulging in highly-seasoned food is gluttony, and experience goes to prove that some young men have stopped the development of their minds through over-indulgence in eating. We can lay down no abstract rule as to quality of food, and this is to be the less regretted, seeing that quality is of little importance compared with quantity. A man may know he has taken too much if he feels inclined to sleep shortly after taking food, and those who experience such lassitude should retrench their meals.

Under this head we would recommend to young lads a careful perusal of Prof. Millar's lectures upon "The bread we eat, the flesh we cook," &c.; and, for further information upon this subject, to read "Health, Life, and Disease," by Dr Johnson of London. We have been led into the foregoing subject, from a practical knowledge of the affinity which subsists between the stomach and the brain. If the former is overloaded, oppressed, or deranged, the latter very soon suffers; and these combined soon disorder the whole body, and render the man incapable of doing his duty.

There are yet other passions which, though different from those mentioned, are fraught with evil consequences to young men. The first of these we should notice is self-complacency. Let every young man guard against the unduly extolling of *self*. Nothing is more certain to prevent a master from imparting counsel and information to a young lad than that of being met with the exclamation, "I know," before the subject is fully laid before him. It is also very sickening to hear a young lad dwelling upon his own good deeds and doings—especially so, if his memory does not fully serve him, and a repetition is made

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of the wonderful story several times. It is well for him to bear in mind the words of the inspired penman, "Let not thine own lips praise thee." A still less pardonable practice, and one also indulged in, is that of dexterously detracting from the quality of others, so as to make themselves important, and stand brilliant in relief against the blackened characters they have soiled. Young man, engrave the lines of Shakspere upon the tablet of your memory :—

> "He that steals my purse steals trash ;
> 'Tis something, nothing ; 'twas mine, 'tis his,
> And has been slave to thousands ;
> But he that filches from me my good name
> Robs me of that which not enriches him,
> And makes me poor indeed."

Another habit of indulgence, and one which lowers a young man greatly, is that of detraction. We have often to lament young men, otherwise amiable, who cannot allow others to be praised. If their merits are pointed out or favourably commented upon, and thus they elicit admiration, this to him is too much, and causes him to express something calculated to dim their lustre. This, it is needless to say, if indulged in by any young man, will bring him into contempt with those of refined and cultivated minds, and hence prevent his rising in the world. Open slander is also a habit of indulgence which some young men give way to, but being more directly offensive than some others, it soon works its own results by bringing the person who is its subject into low contempt. Having, as it were, fortified the young man against outward assault, and prescribed for him against general disaster, and thus far prepared him for entering the duties of his profession to the highest degree consistent with his inherent natural abilities, our next object will be to shew wherein consists his duty, and the discharging it in connexion with the practical duties of forestry. He requires, in the first place, a thorough knowledge of the structure and formation of all plants he has to do with, together with a well-grounded knowledge of the laws which regulate their growth. In other words, he must be thoroughly conversant with the science of botanical physiology, must know correctly all about the growth of plants, and be able to explain the connexion and relation of all their parts. Unless he knows what office the roots fulfil to the branch, and the leaf to the roots, he is unable sufficiently to care for or assist them in fulfilling their functions in life. He must know well all about the channels or vessels which the sap traverses, the existing causes of the sap flowing, the various changes it undergoes, and the duty it fulfils in the vegetable economy. These, and various other subjects therewith connected, must be thoroughly mastered by him; and, in order to do so, books must be read upon the subject, and hours of undivided attention given to it; sleep must occasionally be lost at night, and one hour or two stolen from the morning before rest or sleep may be enjoyed. No definite rule can be laid down for study, but that which we personally prefer is to erect a theory and reason it out, *pro* and *con*, meanwhile writing the thoughts as they occur, and to leave no source unsearched whereby enlightenment may be obtained. We would recommend the perusal and study of "Jane Marcet's Conversations on Botany," which embodies De Candole's theory, which, in our humble opinion, is the best extant. But in order to form comparisons, the young lad should peruse several books upon the same subject, including Lindley's, Louden's, and Rhind's writings.

Agricultural chemistry should also be read and studied. This is necessary in order to know the soils adapted to each plant, and to know the preparations of each soil which agrees and disagrees with the healthy development of the plant. It is a well-known fact that while some soils sustain and nourish a plant, others will kill it. The killing properties of the soil must, therefore, be found out, and also the nourishing properties. As that which constitutes the food of one plant and kills another is a subject matter of deep study, time, patience, and perseverance must all be united in finding it out.

Geology is also of considerable importance

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to foresters, but as they have to deal more with the soil than the rocks, it is not so absolutely essential to know. We, however, would, by all means, class it amongst the subjects of their study, and recommend the geological maps of Johnston.

Without a well-grounded practical knowledge of the preceding subjects, a man may be considered only half-fledged; hence, must fall short of soaring to eminence or performing the necessary duties of arboriculture.

Book learning is very commendable—nay, essential to the qualification of a forester; but this, even when complete, is only a minor part of education. Indeed, the forester whose instructions are only derived from books is, in the true sense, no forester at all. Of two men, the one taught from books without forest practice, and the other a forest-taught man without books, the latter is the most worthy, but each separately is only half what a man is who is taught both from books and the forest. Before leaving the subject of education, as considered necessary for a first-class forester, we cannot omit the great importance of drawing, which should embrace mathematical, architectural, and sketching. Land measuring is also of such vital importance that its daily practice necessitates its thorough study.

Of all kinds of teaching enumerated, none is so important to young foresters as that received in the forest, and to which all others must stand subordinate. The one is the theory, the other is the practice. The one makes a theoretical man, and the other a practical one.

When the work to be performed consists of manual labour, it is necessary that the operator be a workman. Pruning, for example, is manual labour; hence the practical forester must be able not only to use but to sharp the knife, and keep it ever with a keen edge, sharp the hand-saw, the spoke-shave, and pruning-chisel. He must also be able to mix and apply paints, and so tone them as to suit the various colours of the bark of the trees. The proper branches to cut off must also be known to him, the time of the year at which they should be cut, and also the process of cutting. This must be done with his own hand, and perseveringly practised, till the master is fully satisfied that he can properly do it.

The rule that applies to pruning applies equally to thinning, planting, and other branches of manual labour; hence these must also be practised till fairly mastered. Cutting down timber may appear a simple process, but it also requires practice, and the young forester must not stand aloof till he can do it. Working with an axe requires also practice, and no forester should be without this practice. It is admitted by all good workmen that keeping the tools in proper order is of no small importance; hence every young lad should be early instructed in shafting and grinding axes. The cross-cut saw being frequently in use, he must be able to trim and sharp it, and continue in the practice till he can do so properly. Setting the teeth of saws to suit different kinds of wood requires considerable skill both of the hand and of the eye; hence practice in this is required also, to do it properly.

Being well trained and practised in grinding edge tools, sharping saws, mixing paints, &c., the next duty is to arrange them properly, orderly, and conveniently in the tool-house, which should be dry and well ventilated, not only to prevent rust, but to preserve other articles, especially ropes, as decaying ropes are worse than useless, and a few days lying in a damp place will render them worthless.

As a simple test of qualification in young foresters, we have much more faith in what may be seen in a tool-house which they keep, than in what they can shew upon a sheet of writing paper. Indeed, this is becoming more and more a test of qualifications, seeing that what a man does and what he has done is much more reliable than that of other tests. Practice in the saw-mill is of too vast importance to be overlooked, and the young forester should acquire experience in the various operations connected with its management and employment.

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A visit or two to the ship-building and boat-building yard, minute inspection of all the timbers in use, where and how they are placed, and a correct statement made of what he sees there, is a lesson which every young man should avail himself of. Travelling is also of great importance to young lads, by way of increasing their general knowledge and expanding their views; hence all due encouragement should be given them to accomplish this on all fit and proper occasions.

Few things are of greater importance to young foresters than a knowledge of *horses*—not so much as respects their points of merit so as to be able to sell or buy, but should embrace everything connected with grooming, feeding, and loading; and in order to attain this knowledge it is imperative that every young lad should be induced to discharge the ordinary duties of groom, carter, and coachman. As foresters invariably have to do with horses, it is thus necessary that they should be practically acquainted with them, and everything belonging to their harness, &c.

Having already far exceeded the contemplated scope of this paper, and yet embraced only a comparatively few things, we must, with reluctance, say to the young forester, good-bye.

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X.—*ON THE BEST MEANS OF INCREASING THE COMFORTS, AND OF IMPROVING THE SOCIAL AND MORAL CONDITION OF UNDER-FORESTERS AND APPRENTICES ON LARGE ESTATES.*

BY PETER M'LAREN, ASSISTANT-FORESTER, CASTLE GRANT.

AS a general rule, proprietors do not feel inclined to give a large salary, even to head foresters. By large, I mean equal to a man's abilities. And as no man can be a thoroughly trained forester without a superior and solid education combined with energy of character, it follows that men possessing these qualities do not care to follow out the profession, however great may be their inclination for it, but rather enter one more remunerative. The reason chiefly urged by proprietors is, that estates do not yield a sufficient profit to enable them to employ that class of men. This is a decided mistake, and it is quite natural to think that men with but a very ordinary education and incompetent training, cannot attain to the same professional eminence as a man with a superior education and a thorough knowledge of the branches of forestry.

The comforts of an under-forester's situation depend very much on the qualification and the carriage towards him of the head forester. If the under-forester or apprentice has a real taste for his profession, a sincere desire to be thoroughly trained, and an energetic spirit ever urging him to gain more information on every subject coming under his notice, then it follows that if the head forester be highly qualified and thoroughly trained himself, he will do everything in his power to assist him. In forestry, as in other professions, there are some young men quite pleased with themselves; when they are raised to an under-forester's situation, they seem quite pleased with the amount of information they possess; in fact, cannot see the necessity for more, provided they always manage to get through their work as easily as possible. It is not expected that a man of this stamp will ever rise, either in a social or moral condition; and, besides, he cannot blame the head forester for lack of attention in him, because he has no ambition himself to increase his comforts.

This is a subject which has been discussed from all the points in view, and the conclusion generally arrived at is, that the Arboricultural Society could do a great deal for young men in the matter. There is one way which would be felt by many as a great incentive and spur—viz., that the Society offer prizes to under-foresters on the best written essays on all the various branches of education bearing on forestry, and that the essays be competed for by assistant foresters only. This would not only encourage the diligent, but spur on the slothful, by making them ashamed of their incompetent knowledge and training. It would be an incentive to every class of under-foresters, through its making them anxious to gain the prize and be taken notice of, besides bringing their abilities and intellectual powers to the test, endowing them with a wish to know more, and find out something new; and, at the same time, almost unconsciously improving their social and moral conditions.

Apprentices are quite different from under-foresters, inasmuch as they are obliged to work constantly in order that they be thoroughly trained. On the amount of perseverance and assiduity they possess, depends very much their future success. The Society would do well to consider the propriety of offering some encouragement to apprentices. The idea of writing essays would spur them on with their education; and, in order to their becoming highly qualified and thoroughly trained foresters, a superior education is necessary: reading, writing, and arithmetic, as a matter of course, are indispensable, for no man can fill even a very humble situation without them. Many a forester is possessed of no more; but a man wishing to rise to the top of his pro-

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fession, and that profession forestry, must have a good knowledge of drawing, so that when improvements are being carried on and estimates thereof made out, he may be able to prepare plans for the improvement. He must also have studied botany, and vegetable physiology, in order that he may be able to know and manage the different kinds of trees and plants, which are the objects of his care; chemistry, that he may know the proper constituents of the various soils for the different kinds of trees and plants, as some trees grow better on one kind of soil than on another; geology, that he may know where to plant the different kinds of trees and shrubs; and entomology, that he may have an idea how to detect and treat diseases in trees occasioned by insects. Of course, it is not expected that a man should know each of these subjects thoroughly, but sufficiently to fit him for his profession; and as he advances in life he may also be advancing in wisdom. Latin is also a very useful acquirement; it is a great aid in the correct pronunciation of botanical words, as well as the correct meanings of many of our English names. If a man possess an education of this stamp, he may expect to rise in his profession, and not only in his profession but in the scale of social life.

In order that under-foresters and apprentices be possessed of such an education—and they, generally speaking, have not had, or have not used, aright the privilege of obtaining a thorough education in their school days—it is necessary that they should endeavour to procure for themselves, either by self-teaching, or at an evening school, or by a combination of both, a fair competent English education as already stated, and at the same time procure by every means in their power a thorough knowledge of their profession, both practically and scientifically, and, depend upon it, ere long they will reap the benefit of their labours. I know of no book I could recommend so much to the notice of young foresters as "Cassell's Popular Educator." It contains simple instructions in book-keeping, botany, chemistry, drawing, plain English, composition and grammar, geography, geology, geometry, land-surveying, penmanship, reading and elocution, and natural history. The proprietor of an estate would confer a great benefit on those under him, if he was to encourage the village teachers to assist the young men employed on his property also in their studies. Every one who has felt the power of education over mind and spirit must confess that without education a man is nothing. It makes men conduct themselves towards their superiors in a becoming manner, and bear themselves in the presence of and towards their inferiors in a way which is sure to command respect. Their moral condition is raised, because they have various subjects to think upon, and are never wearied trying to find out still more concerning these subjects, so that their minds are invariably raised above the mere common-place talk of uneducated men; and if they study nature with the view to improving themselves, it is impossible but that they, being gratified, and their minds elevated as they go on improving, must of necessity worship and reverence Nature's God. In fine, education is, in my opinion, the best means of increasing the comforts and of improving the social and moral conditions of under-foresters and apprentices employed on large estates.

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XI.—*ON SOME NEW KINDS OF STRAINING PILLARS FOR WIRE FENCES.*

BY CHRISTOPHER YOUNG MICHIE, FORESTER, CULLEN HOUSE.

AMONGST the various requirements of forestry, none perhaps stand higher than fencing; and of all rural enterprises, none, perhaps, is increasing more rapidly than that of wire-fencing; as many miles of it are being probably now erected annually as there were yards of it ten or fifteen years ago. This large annual increase may be accounted for in various ways, such as the extension of agricultural and arboricultural improvements, the portableness of iron fences for districts difficult of access, such as bog, moss, glen, or rocky mountain, together with the comparative cheapness of it as a fence, its general utility and durability.

Two difficulties have hitherto stood much in the way of its further adoption, the one is its comparatively temporary endurance as a fence, consequent on the decay of the wooden straining-posts which constitute its mainstay and support; the other, either the want of properly qualified persons to erect it, or of having it done at too great expense.

The first of these is here overcome in the acquisition of a cheap and efficient malleable iron straining pillar, which renders the fence so far a permanent one. The second is likewise here met in the simplicity of the pillars, which makes it cheaply and easily erected by any ordinary workman.

The writer, knowing practically the real difficulties which have uniformly stood in the way of wire-fencing, has finally surmounted these, so far as his own experience determines; but how far this has been achieved, in the opinion of others, remains yet to be known. He having of late had a large amount of work to do in the way of fencing plantations, which were originally inclosed with turf dykes, met with an array of difficulties, which he foresaw must either be overcome or the work be done imperfectly, or done at an unwarrantable expense.

It is well known to all practical men that in no soil or situation do wooden posts decay sooner than in turf dykes; even the best quality of larch remains good only a few years. It is also known that upon the straining and tying pillars of all wire fences depend their stability and durability.

The plantation fences referred to were intended to be permanent, which implied that all the principal pillars were to be of iron.

There was nothing peculiar about the turf dykes, but they were, like most others inclosing plantations, a general succession of straights, curves, depressions, and elevations, with angles of almost every degree.

After going carefully over all the fences to ascertain precisely what was required in respect to materials, it was no difficult task so far as related to wire, staples, and wooden posts, but it was far otherwise in regard to metal pillars. It was found necessary in ordering these to state the number of wires required to be put on, and the distance between the wires. This may appear in theory no difficult task to perform, but in practice it is far otherwise. The chief obstacle lay in the circumstance that the dykes were all of different heights, and in many cases a few hundred yards required four wires, while the next stretch required only two. The whole circumstances are so well known to practical men as to need no further explanation.

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It was resolved that all straining pillars should be self-acting; this is peculiarly necessary upon fences with so many curves. But, as is generally known, all the ordinary self-acting straining pillars are made with the brackets fixtures, hence can only answer for one set of fences, and wires at a specified distance; and the writer, after searching the market all over, found no such pillar as would accommodate in the way required.

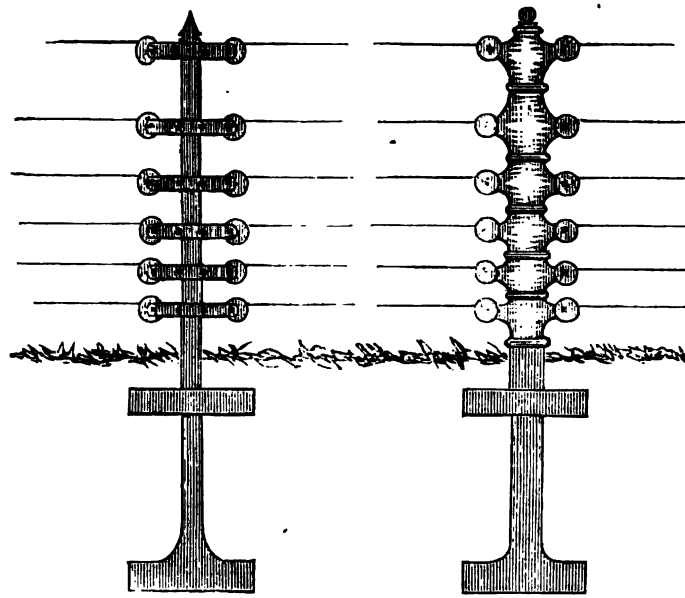
He tried all the more recently invented and improved pillars, and found them all deficient in what was wanted of the brackets—viz., to move up and down so as to form any desired space between, and suit any number of wires. In this dilemna, he turned his mind to the subject in good earnest, and after much labour, repeated failures, and renewed efforts, at last succeeded in making a complete set of moveable bracket pillars, equal to all the requirements of the case, or such as are likely ever to occur in ordinary wire-fencing.

Without further details, the writer will endeavour to describe briefly each pillar separately, and explain its use and place in the fence.

Every practical man knows that in any extensive fence, several descriptions of pillars are required to suit the various purposes and situations in the fence.

So far as the writer's experience goes, five essentially different descriptions of pillars are required for ordinary fencing, and these occasionally require slight alterations, but only such as can be done without in any important way altering the pillars. These five, be it observed, are exclusive of intermediate posts, but include gate pillars.

No. 1 is termed the double-action accommodation bracket pillar, from the twofold office it fulfils in straining the wires. It may



No. 1.—Plain. No. 1.—Ornamental.

be placed in any straight, or nearly straight, part of the fence, between the two posts to which the wires must be attached. It strains the wires on each side to almost any distance, but 300 yards are preferable to a greater number, as the wire is less tight the longer it is between the strainer.

This pillar requires no side supports, as it is drawn equally on both sides, and is assumed to be placed in a straight part of the fence. The circumstance of requiring no stays makes it a very cheap pillar, considering the amount of straining it performs.

In erecting a single line of fence of any

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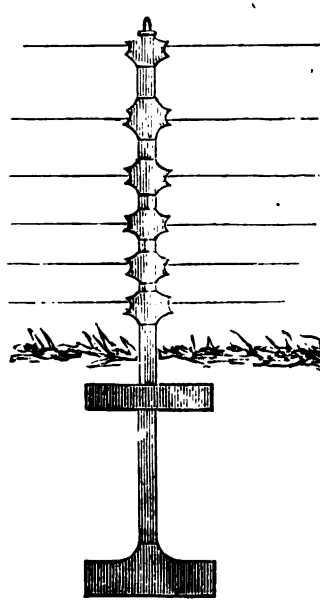
distance, from 500 to 1000 yards or upwards, only one such pillar is required, with two others different, one for each end of the fence as tyers.

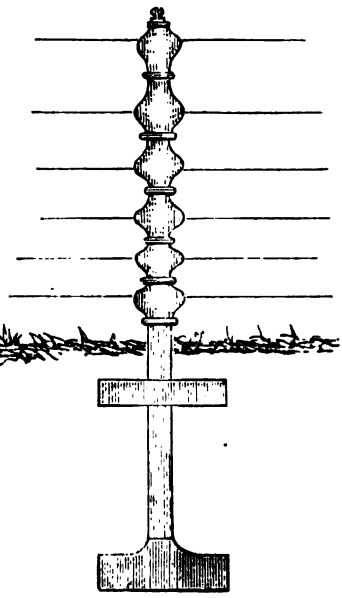
No. 2 is a double-action bracket pillar, being adapted to stand at a corner where two fences meet, forming an angle nearly square.

Like No. 1, it also strains two separate sets of wires, but differs from it in straining them in opposite directions. A four-sided field or plantation, where the fences run at nearly right angles with each other, requires only two pillars to strain the whole line of fence, if the fence is along a burn or river side, or margin of a plantation, a slight alteration of the bracket, by rivetting a staple in the close end of it, will adapt it to a fence of short straights, or zig-zag form of fence. This pillar requires a stay in most positions where it is placed, but if used in a continuation fence, no stays are required.

No. 4 is the turning pillar, which is used at angles of the fence to enable the wire to pass easily round. It consists of a round solid iron bar *above ground*, and brackets or sheaves, of a peculiar make, partly fixed and



No. 4.—Plain.



No. 4.—Ornamental.

though 4000 yards in length. This is, of course, exclusive of gate posts. Each of the pillars require an inside stay, which, together with the angle brackets, make them more expensive than fig. 1; but considering that each does the usual work of two, they are very cheap.

No. 3 is the single action pillar, which is either adapted for the end of a fence, continuation of a fence, or to act as straining-pillar and gate-post combined. Two of these pillars, placed at opposite ends of a fence, distant from each other from 500 to 1000 yards, will strain the wires completely. Or partly loose, which move upon the bar as the wire passes round them; but it is square and fixed the same as the others underneath the surface of the ground.

The stay of this pillar is not attached, as the others are, with a bolt and nut, but is made with a round hole, in form of a loop, which passes over the top of the pillar after all the brackets are put on except the upper one, and the foot of it is fastened like the others into the ground.

No. 5 is the vertical accommodation pillar, which fills a place in the practice of wire-fencing long and much required. It is

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adapted for carrying the fence through deep ravines, and over sharp eminences. The brackets are placed upon the pillars vertically, and secured to it with thin wedges. If the position is in the bottom of a glen or ravine, the wires are put underneath the brackets; but if, on the other hand, it is upon an eminence, the wires are placed on the tqp of the brackets. This pillar, being often placed in sand or moss, might be liable to be drawn up out of the ground, with the perpendicular strain put upon it; but to prevent this, it has a very broad flanged base, and, moreover, may be placed at any depth with a very little additional expense, which makes it perfectly secure against such an occurrence.

As already stated, these five different pillars comprise all that is likely ever to be required in plain wire-fencing, and may be either so placed as to suit any emergency likely to occur, or admit of slight alterations, such as gate fastenings, &c., without entailing any new principle in the pillar.

The principal parts of the pillars are all malleable iron, and only the rollers of the brackets, and the flanges which secure them underneath the ground, are cast metal.

The pillars, brackets, and fastenings are all made separately, and are fitted together at the place where to be erected. This is a great convenience in many ways, such as in handling them, carriage, &c. When once laid down the common workmen can fit them together as expeditiously as a tradesman would do; as in doing of it there is scarcely a wrong way that can be taken.

The writer, like many others, having to do with erecting two kinds of wire-fencing, the one plain, and only for utility, the other ornamental, and to please the eye.

Finding that the pillars described were scarcely such as could be adopted in a first-class demesne, but that the principle of them was good, he further laboured to convert or transform them into ornamental pillars. The plan, like most others, when found out, was simple. The whole pillar, or at least all of it above ground, is encased in metal plates fitted on in sections. The whole is fitted on or mounted by beginning at the base, and working upward, each part secures the other last put on, till the top ball is fixed which secures the whole.

Without here mentioning others, one great advantage consists in the circumstance that, should an accident occur to the pillar, the part broken can be replaced at a trifling expense; whereas, in the ordinary metal pillars, a single stroke of a cart-wheel often renders them quite useless.

From pecuniary consideration, on behalf of the Scottish Arboricultural Society, the writer deems it prudent to annex only four drawings, two of the plain, No. 1 and No. 4, and two of the ornamental encasement pillars.

The real and main advantage of this system of pillars consists in the movability of the brackets which admit of any distance between the wires, and any number of wires being used at pleasure. The other advantages, which are by no means unimportant, or to be overlooked, will be better seen than understood by description, and as the writer contemplates exhibiting a model of the pillars described at the forthcoming annual meeting of the Scottish Arboricultural Society, the judges will be better enabled to determine their merits on that occasion.

[A beautifully executed model was placed on the table for exhibition at the Annual General Meeting, held 4th November 1868, and was highly approved of by the members present.—Ed.]

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XII.—*WIRE-FENCING, WITH WROUGHT IRON STANDARDS AND STRAINING POSTS SET IN STONE BLOCKS.*

BY JAMES KAY, HEDGER, BUTE ESTATE.

FOR a six-wire fence, to stand 3½ feet high, the straining posts should be formed of 1½-inch bar iron 4 feet long, which will leave about 5 inches to be rounded and barbed at the end for fixing into stone. The straining posts should be pierced with oblong holes, so as to admit two lines of the largest number of fence wire. The intermediates should be 1½ inches, by ⅜ inches, and 4 feet long, which leaves the same length to be barbed for fixing into stone, and pierced with ⅜-inch holes for the three top wires; the others may be smaller so as to admit the number of wire used for fencing, and to allow a key being driven in after the fence is erected, so that they may not be driven aside by cattle. There will be a stay required at each end of the fence only, as the intermediate stretches can be made to support each other, a temporary stay being only used while the work is in progress. The stones for fastening the straining posts into should not be less than 2 feet square and 18 inches thick; the stones for the intermediates, 18 inches square and 12 inches thick. If suitable boulders can be got, whether whin or freestone, they may be used.

Mode of Erecting.—Stake off the line of fence, and lay down the "line" in that direction; afterwards take a rod 6 feet long, or whatever the distance is to be between the intermediates, and begin by putting a peg or mark into the ground at the end of the fence, and one at every 6 feet along the whole line. Next, a workman with a spade and pick will be required to dig the pits for the stones. In digging the pits, they should be made a little wider than the stones, say 9 inches, in order that they may be got properly fastened by beating down the earth, but as near the depth of the stone as possible, so that the stones may be got turfed over without being raised above the natural level. The stones should be bored with "jumpers" about ¼ inch larger than the size of the iron, and in boring the holes should be kept rather wider at the botton than at the top—what is termed "dovetailed"—so that the standard may not be pulled out. The next process is to have the standard fastened into the stone with lead or rock brimstone melted over a slow fire, and mixed with sharp dried sand.* In using brimstone, great care should be taken in having the holes cleaned out, as the least dust will be liable to leave the standard slack, and, not being like lead, it can't be fastened afterwards. After having the standards fastened into the stones, put the straining posts in position, by having them plumbed and made solid. Next, the stays must be put up at the end of the fence. They are generally constructed of two pieces of flat iron, 5 feet long by 1½ by ⅜ inch, rivetted together at about one-third of their length from each end, a small piece of iron about ¼ inch thick and the same breadth as the stay being put betwixt them, so as to leave room for the wire to pass through freely. The ends are welded together, and the end that goes into the stone rounded and barbed so as to hold properly. The upper end is bevelled so as to lie flat against the straining post, under a small projection about 3 inches below the top wire. The standard and stay are rivetted together, or fastened with a bolt and nut, and the bottom end made fast with lead or brimstone. Next, put all the intermediates into the

* A compound of brimstone, &c., termed "lava," sold at 14s. per cwt., may be had from John Smith, 25 Great Dove Hill Street, Glasgow. It is considered better than lead, and will go six times as far.

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pits. Afterwards take the line, and fasten it in the top wire hole in the straining posts at the end of the fence, and pass it through all the intermediates to the next straining post. Have the line pulled up and kept tense, by attaching a weight to the end of it. This will give a sure guide for levelling the standards, as what is high can be lowered, and what is low can be raised by putting in a little earth, and beating it firm, so that it may not subside afterwards—a point of particular importance. In bringing the standards to a line, this is easily done by altering the stones a little to one side or other. In going round a curve, a line is laid along the ground and pinned out in the form of the required curve; then all that is required is to plumb the standards and make one edge touch the line, which will put them in position. Having all ready, the wires are fastened to one of the straining posts, and run through all the intermediates, observing that none of the knots or splices come in contact with the standards; if this is likely to take place, the wire must be shortened at that part. The next process is to have the wires strained, which is done in the usual way. A small iron wedge or pin will be required to hold the wires till once they are fastened round the post. Keys—small pieces of half-round iron, in the form of a wedge—will be required to fasten the wires in the intermediates, so that they may not be driven aside by cattle. Two wedges, one on each side of the top wires, will do; the one key to be driven off one side, the other to be driven off the other.

In going round curves, stays will be required to support the standards. They may be formed of either round or square iron, and are fastened into stone blocks, and rivetted to the standards. But stays should be used as little as possible, as they disfigure the appearance of the fence, and are liable to be bent by cattle.

Wire-fence standards are now constructed in an endless variety of forms, so as to dispense with stone blocks, and are generally named according to their form, such as triangular-foot, anchor-foot, flange-foot, tripod-foot, sleeper-foot, &c. &c.

Screw-eye bolts for tightening the wires are sometimes used, but are only suitable for the ends of a fence; and even then they are not of much advantage, for after the wires are taken up two or three times, the points of the bolts project past the post, and are dangerous for cattle.

Improved self-winding straining pillars are now extensively adopted, and, though expensive at first, must be the cheapest in the long run, and the most effective for keeping a wire-fence in order, as the wires can be kept strained to the greatest nicety, which is the great principle of a wire-fence. In fact, a wire-fence wholly depends on being kept strained, for if not, it is the most miserable fence extant. There are various forms of improved straining pillars, descriptions of which may be seen on looking through the catalogues sent out by wire-fence constructors, and are, though of different forms, nearly all on the same principle; therefore, we shall not attempt to particularise, but simply say that where a wire-fence is intended to be permanent they should always be used as far as practicable.

The following is an outline of the construction of a straining post which the writer has used, and which, for ordinary purposes, answers very well, and is not very expensive, and can be easily constructed by any handy blacksmith.

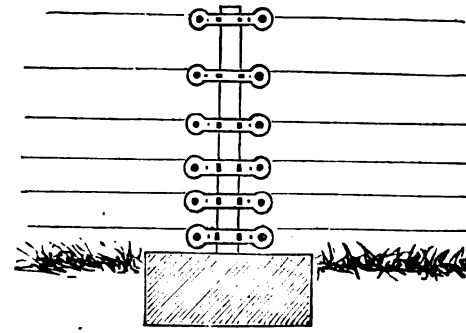

Fig. 1.

The straining post, fig. 1, is formed of 1½-inch square bar-iron, 4 feet long if for a six-wire fence to stand 3½ feet high, fastened into a stone block in the usual way. There is no stay required in intermediate stretches, as one

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stretch supports the other. The appliances for straining the wires, fig. 2, are two winders

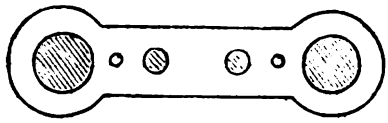

Fig. 3.

(W), turning in two iron plates (P), which are fastened with two bolts (*b*), one on each side of the iron bar (B). The plates are 7½ inches long, and 1½ inches broad, by ⅜ inch thick, in the form of fig. 3.

It will be seen that each straining post serves to strain two stretchers, one on each side of the straining post. As 200 yards is not too much for a stretch, where the line of fence is straight, one straining post will strain 400 yards. Where rigid economy in the first cost is an object, and where there is a long line of fence, a wooden post can be erected between the straining posts for fastening the wires to. Under any circumstances, however, it would be better to use an iron post, as it will not cost much more, being only a plain bar of iron—no winders being required for

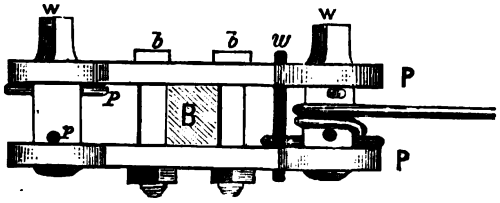

Fig. 2.

The winders are formed of inch round iron, 3½ inches long, three-fourths of an inch of the end of each being formed square, and projecting on one side of the plates for the purpose of being turned by a key when straining the wires. There are two iron pins (*p*) inserted in the winder, cross to each other and close to the inside of each plate. They project about three-fourths of an inch on each side of the winder, and serve to keep the winder in its place, and also to hold the wire, the end of

the intermediate posts. Fig. 4 is another form of winder, formed with a bolt and nut, for fastening into a wooden post. In using

Fig. 4.

hard-tempered wire it will be found an advantage to soften a foot or two of the ends of the wires by heating, which renders it more pli-

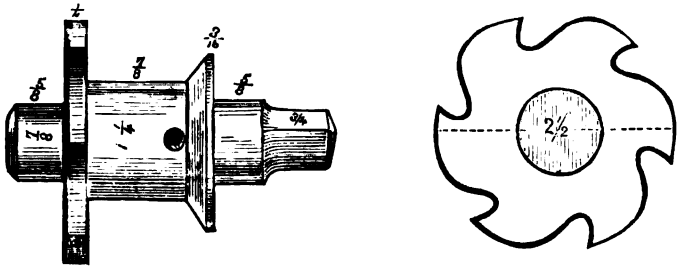

Fig. 5.

which inserted in a hole in the winder, at every quarter turn, by a piece of wire (*w*) which is put through the small hole in the plates near the winder.

able, and not so liable to break when winding or unwinding it.

The winders and plates for iron-straining posts may be formed of cast-iron, in the form

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of fig. 5, and are little more than half the cost of malleable iron. By having a pattern made, any quantity may be cast to order. The cost is 1s. 6d. per pair, with bolts.

NOTE.—In the erecting of wire-fences it is sometimes necessary, though the fence may be erected with wood posts, to erect iron standards where the line of fence may come in contact with rock. The following is the method of obtaining the exact length of the standards: stretch the line along the ground, and have it brought to a level by putting in bearings to raise it to the level you would have the bottom wire. The distance between the standards are then marked off, and the distance from the line to the rock measured at these parts, which should be noted and numbered for easy reference afterwards. This will give the exact length from the bottom wire to the surface of the rock, which, added to the height of the fence above the bottom wire and the part fixed into the rock, will give the total length of the standard.

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XIII.—*REMARKS UPON CONIFERÆ GROWN AT POWERSCOURT, CO. WICKLOW, IRELAND.*

BY CHARLES S. FRANCE, FORESTER, POWERSCOURT.

AMONG the recent introductions of exotic plants none has been of greater use to he planter or landscape-gardener than those belonging to the natural order coniferæ. They combine beautiful symmetry with rich luxuriance, and apart from that, the many varieties of colour and shade they possess is enough to recommend them to all admirers of sylvan beauty. Varied as they are in species, and having been already fully described and reported on by esteemed members of this Society, I do not think it necessary to go into the merits and demerits of the different species. My object in these remarks is to lay before the Society the progress they have made, and the mode of trying their capabilities, adopted at Powerscourt, as I think it may be interesting.

The ostensible object in planting pinetums, apart from ornamental purposes, is to test the qualities and hardiness of the different kinds for ultimate timber trees in Britain, or, in other words, to find out if any of them, by their quality of timber and rapidity of growth, will replace some of our present timber trees, and return a greater amount of profit to the planter. Such being the case, I believe this object can never be attained by the present mode—viz., of selecting a piece of ground, say 5 or 6 acres, and dotting down a variety of plants promiscuously—for this reason, the soil that suits one sort may be very detrimental to another; for example, the soil that will suit a Pinus insignis will not suit a Taxodium or Sequoia sempervirens, and the proper situations for the different sorts vary quite as much, therefore it is not a fair test, and the consequence is, that people are very liable to say that one sort is worthy of cultivation while another is useless; and the fact may be, that the fault does not arise from the nature of the plant, but from the improper soil and situation it is planted in. Another objection that I have to planting coniferæ in this way, is, they are not enough sheltered in most instances. Plants in their native habitats generally grow close together, and render mutual shelter to each other; therefore so long as their proximity does not interfere with their proper development and the due elaboration of their juices, it is beneficial that plants should grow as close together as possible.

In planting, the general practice is to make large pits, put in a lot of fine mould, and have the plants from 30 to 40 feet apart. Suppose we should plant larch and Scotch fir, or any other timber tree, in this way, what would be the consequence? I am sure every tree we have would be pronounced a failure, simply because they had not the necessary protection when young, and also in consequence of their getting too great a space for the production of laterals, and thereby detracting from their timber-forming capabilities. Another detrimental consequence of this mode of treatment is, that they require a great deal of pruning or pointing to prevent the branches from contending with the leader. Now the pruning or pointing of any tree, more especially conifers, is, under any circumstance, more or less injurious to their healthy growth. There is no doubt but that at certain seasons it is less hurtful than at others, but still, if it can be avoided by any other simple means less hurtful, I should say, use those means. With this object in view, we have adopted quite a different method from the foregoing in planting coniferæ.

Powerscourt is situated on the north-eastern slopes of the Wicklow mountains, at an elevation of from 500 to 700 feet above the level of the sea, and the soil is principally a light loam, with a very porous gravelly subsoil; in some parts, however, it is of a peaty nature

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containing a good deal of lime, therefore, instead of selecting a piece of ground and planting it as a pinetum, we have planted coniferæ in every soil and situation throughout the plantations. In light loamy soils we plant the Picea, Pinus, Wellingtonia, Cupressus, and Thuja tribes, and in peaty and moist situations the Abies, Araucaria, Cryptomeria, and Taxodium tribes, in which situations I find them to do remarkably well.

As a further test of the capabilities of the Araucaria imbricata, I have planted, by the direction of Lord Powerscourt, a large quantity of them in a young mixed plantation on a light sandy soil, and at distances of about 40 feet apart. This was planted about two years ago, and they are making very satisfactory progress. The object here is to allow the other species to grow up for a time as nurses, then gradually cut them away, so that the Araucaria may be the permanent crop.

I have also planted, in a similar manner, a great many of Abies Douglasii, and Pinus insignis, and given them the same treatment as the common sorts, and I find them to grow faster under such treatment than when planted singly in the open, and bid fair to become most useful timber trees at no very distant date.

I herewith subjoin a list of a few of the principal sorts grown at Powerscourt, with the date of planting, and their present height, with a few remarks on their condition, and probable usefulness.

Name.	Date of Planting.	Height in Feet.	Remarks.
Abies Albertiana	1863	9	Grows freely on light dry loam.
,, Douglasii	1855	28	Planted extensively; very fast grower.
,, Menziesii	1863	7	Very healthy.
,, Morinda	1855	12	Very graceful habit, and grows freely.
,, nigra	1846	26	Slow compact growth.
,, orientalis	1866	3	Do.
Araucaria imbricata	1855	17	Doing fair.
Cedrus Atlantica	1864	10	Free growing.
,, Deodara	1857	28	Very free growing, and hardy.
Cryptomeria Japonica	1853	36	Do. do.
,, Lobbii	1864	17	Do. do.
Cupressus Knightii	1866	6	Graceful, and free grower.
,, Lawsoniana	1863	12	Grows freely, but indifferent habit.
,, macrocarpa	1856	36	Spread of branches 29 feet: very fine specimen.
,, sempervirens	1861	12	Grows freely.
,, torulosa	1866	5	Good habit; free growth.
Juniperus excelsa	1863	6½	Fine compact habit.
,, sinensis	1864	8	Grows freely.
Libocedrus Chilensis	1863	6	Moderate growth.
Picea Cephalonica	1863	11	Good habit; grows freely.
,, cilicica	1867	4	Do. do.
,, grandis	1863	7	Very fine and healthy.
,, lasiocarpa	1864	10	Do. do.
,, magnifica	1866	4	Do. do.
,, nobilis	1864	8	Do. do.
,, Nordmanniana	1861	6	Moderate growth; extra fine habit.
,, Pindrow	1865	6	Growing strong.
,, Pinsapo	1864	8½	Growing freely; fine habit.
Pinus Austriaca	1855	19	Moderate grower; good habit.
,, Benthamiana	1864	7	Growing strong.
,, Cembra	1855	15	Compact habit.
,, excelsa	1855	30	Growing very fast.
,, insignis	1855	36	Growing freely; quite hardy.
Pinus Jeffreyii	1865	6	Healthy.
Lambertiana	1863	14	Growing fast, and healthy.

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Name	Date of Planting.	Height in Feet.	Remarks.
Pinus macrocarpa	1863	8	Very fine, strong grower.
,, monticola	1863	7	Doing fair.
,, Pinaster	1830	45	Good timber tree.
,, ponderosa	1863	6	Robust grower.
,, Pyrenaica	1864	8	Most useful hardy sort.
,, Strobus	1838	50	Good timber tree.
Sequoia sempervirens	1855	31	Grows freely in sheltered situations.
Taxodium distichum	1866	10	Grows freely.
Taxus baccata	Uncertain	50	Fine old tree, 10 feet of clean stem.
Thujopsis borealis	1863	12	Best of all ornamental conifers.
,, dolabrata	1866	3	Very graceful.
Thuja gigantea	1861	5	Good habit.
,, Lobbii	1864	12	Fine ornamental tree; grows fast.
,, occidentalis	1855	25	Moderate growth and habit.
Wellingtonia gigantea	1858	18	Doing well; growing very fast.

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XIV.—*ON THE CEDRUS ATLANTICA.*

BY HUGH FRASER, LEITH-WALK NURSERIES, EDINBURGH.

THE native habitat of the Cedrus Atlantica is on the highest mountains of Barbary, and specially on the Great Atlas range in Northern Africa, where it is found in great abundance at an elevation of from 5000 to 10,000 feet above the level of the sea, and reported as a noble and picturesque tree, attaining a height of from 70 to 100 feet, with a proportionate girth of trunk. Its timber is extensively used, being durable and easily worked, not quite, though nearly, equal to that of the Deodar, but very much superior to that of the Cedar of Lebanon.

In leaves and branches it very much resembles the Cedar of Lebanon, but easily distinguished from their silvery appearance, and from the leaves being shorter and denser than the Lebanon; while in general appearance the tree presents a combination of the characteristics of both the other species, having the tall straight tapering habit of the Deodar on the one hand, with the stiff horizontal branches of the Lebanon on the other.

Since its introduction into this country about the year 1845, and particularly during the last 10 or 12 years, it has been largely used in ornamental plantations and shrubberies, and is much appreciated as one of the handsomest of our hardy conifers—its shining silvery foliage and straight symmetrical appearance presenting a striking and pleasing contrast to the darker green of the other plants with which it is usually associated. It has, however, attracted comparatively little attention among practical foresters; as an important addition to their list of hardy useful timber trees. That it is well adapted for this purpose has been amply demonstrated by the experience of the last few years, during which our winters have been as intense, and our spring and early autumn frosts as trying for plants as any in the present century, thus subjecting exotics to the most severe tests. While the Deodar, Araucaria, and many other trees hitherto considered perfectly hardy in this country, were either killed outright or very much damaged, unless sheltered or in otherwise favourable circumstances, in the storm of 1860-1, as far as I have been able to ascertain, the Cedrus Atlantica sustained no injury whatever. Though the soil of the Atlas range is for the most part calcareous, the rocks being composed of mountain limestone, with occasional dykes of igneous rock, this tree has proved by no means fastidious, and is found to thrive in almost every geological formation in this country—growing with equal luxuriance among the loams and clays of the *debris* of granite and trap, with those of the sandstone system; while in the lias and chalk of England, it grows with extreme vigour. Generally speaking, however, nothing suits it better than a moderately rich loam with a fair proportion of decomposed vegetable matter, in a situation neither too dry nor too damp; in short, wherever a soil and situation suitable for the common spruce fir can be found, I would have no hesitation in planting the Cedrus Atlantica.

In selecting young plants for the woods, there is no better size than from 1½ to 3 feet, although much larger trees may be removed with perfect safety; and the best season for planting is spring, as soon as possible after the breaking up of the severe frost of winter, choosing such weather as will insure the soil being properly firmed about the roots without being soddened. Like the spruce and Scots fir, little progress in the way of growth may be expected for the first year or two after planting, even in the most favourable circumstances; but when once established the Cedar will shoot up with wonderful rapidity, and, in good situations, rival the larch itself. It may be noticed that although 1845 is given as the

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date of its first introduction into this country as a distinct species, there are several examples, both in England and Scotland, of trees which must have been planted considerably earlier, and which from their close resemblance to the Cedar of Lebanon, have been regarded as mere varieties. Their upright habit, glaucous colour, as well as the smaller size of the cones, however, prove their identity with the African species beyond any reasonable doubt; and it is quite likely that small quantities of seeds may have been imported into private establishments, as its native mountains have been long well known and accessible to travellers. Among the best examples of such trees and proving their adaptability as a British timber tree are some in the extensive park of Belvoir Castle, Lincolnshire, the seat of the Duke of Rutland. On a recent visit to that place, Mr James Parker, the intelligent head forester, shewed me several noble specimens, one of which I procured the dimensions of: height 60 feet, stem at 1 foot from the ground, 7 feet 4 inches in circumference, and the spread or diameter of the branches 41 feet. The other specimens have straight stems, but in this, the largest, the trunk branches off at 6 feet from the ground, into two upright stems, the one an almost exact counterpart of the other, and presenting the appearance of two fine trees growing side by side. There is at present (autumn 1868), upwards of 500 cones on this tree full of seeds and nearly ripe.

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XV.—*ON THE ADVANTAGES AND DISADVANTAGES OF THE NATURAL AND ARTIFICIAL SYSTEMS OF REARING FOREST TREES.*

BY A. E. WILD, FORSTPRAKTIKANT, EISEWACH, GERMANY.

BEFORE entering upon a closer examination of our subject, it would perhaps not be without interest to give as introduction a small history of the artificial rearing of woods. In earlier times, and until the middle of last century, when the felling of trees was carried on without any regard to the state or maintenance of the forest, and regeneration was left to nature, artificial means were only employed in such cases when it concerned the planting of waste grounds; it was when this system became by degrees supplanted by a more organised management of the forests, and when nature ceased to make up the blanks caused by injudicious felling, that necessity first taught man to have recourse to his own hand for the filling up these gaps. This method of cultivation found, however, a still greater use through the total clearing, which began to be practised in the pine forests of mountainous districts, on account of this tree suffering so much from the wind. This system of rearing is now at the present time not only employed in the maintenance and rearing of such forests, which, either on account of the nature of the trees comprising them, or from the influence of the elements, are not capable of being raised from the seed of a certain number of mother trees left standing—as, for example, the pine and Scots fir, and by the transformation of low brushwood tracts into tall wood—but also by other forest trees; and in all cases, where this method can be practised, with quite as good a result, and with only small expenditure. It has, moreover, gained for itself an independent position in the rearing of forests, and takes the precedence in many cases of raising from the seed of mother trees.

Each of these methods of cultivation has, however, its peculiar advantages, which require respective consideration before we decide in any particular case either for the one or the other.

As advantages of the system of rearing by means of seeds that fall from the mother trees, we may mention the following points:

1. The above method is to be preferred in such cases where no particular impediments present themselves without any cost, or at least with only little artificial help. The artificial rearing, on the contrary, requires an expenditure for material (seeds or plants) and for workmen.

2. The natural protection afforded by the mother trees, required by many kinds of plants during their growth could only be replaced by expensive artificial means, if we were to forsake the way of nature and clear the forest completely. Besides that, the growth of such plants as thrive best in the shade would be much greater up to a certain age than if they did not enjoy that protection.

3. When the felling of all the trees takes place at one time, *i.e.*, when the artificial system is employed, the tract thus laid bare must be exposed to the influence of the sun and dry winds, which work more or less detrimentally on the soil according to the space of time which elapses ere the ground can be replanted; whereas, by the method of allowing so many trees to stand in order to sow seed, this drying up of the soil cannot take place to such an extent.

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4. When man has recourse to nature for the sowing of his forest tract, and prepares the trees and soil by successive fellings, the trees thus left standing for the purpose of regeneration and protection to the young progeny in its first growth, increase considerably in diameter, on account of having more light and room; and to this increase of wood we may also reckon at the same time a corresponding increase in the value of the trees, which, were we to employ the system of felling the whole at one time, would be lost.

5. The natural method affords, as a rule, a more compact condition, and, as a consequence, a straighter bole, more free from lateral branches than it might otherwise be. Attention must here be paid that the young plants in this compact condition do not grow too slender, which, however, can easily be hindered when the thinning takes place at the proper time, and is continued when necessary.

Having thus put forward the advantages which the system of rearing forests from mother trees afford, let us now consider the dark side of this operation, or, as we may also say, the advantages which the artificial system has for the forester.

1. We can employ the artificial method on barren and unwooded tracts, whereas, in the other method, there must always be a certain amount of trees already standing.

2. It very often happens that the natural sowing is not of itself sufficient to form a regular and perfect wood, which depends, more or less, on the casual fruitfulness of the seed trees. It is also impossible by this system to adjust the errors which are often made, either of felling too many or too few trees.

3. We are thus enabled to maintain the desired degree of mixture and the distribution of the different species in mixed woods in such places as suit their constitutions, &c., which otherwise would entail a particular expenditure.

4. The management of the woods, if we wish to rear from mother trees, is often attended with many difficulties, and requires particular attention and ability which, by the artificial method, is not necessary.

The irregularity of the seed years causes often the fixed period for felling either to be interfered with, or the wood must be cut all at once too freely, thereby placing the forest too open.

An error which is very generally made may also here easily be committed, viz.: When a plentiful seed year is in prospect from such trees as only bear seed during long intervals, we easily prepare a too large tract, and are then not able to finish the after-cut in proper time.

5. It is not always possible when we make use of the natural system to adhere to the fixed time when the forest should be regenerated by such kind of trees as do not bear seed yearly, but only after long and undeterminable intervals. When a seed year does not occur till much later than was expected, we can then neither continue the generation nor yet the harvest, which is dependent upon the former, thereby often causing great embarrassment in adhering to the fixed yearly supply of wood.

6. A great deal of injury is done to the young progeny by felling the mother trees, and especially when these are cut in summer, and are brought out of the forest in large quantities. We are also not in a position to prevent the mother trees being often blown down by the wind, thus causing much damage to the young plants.

7. By the natural method, the digging up of the roots is in many cases impossible, thus making a loss of root-wood, which, by the other mode, could be easily gained.

8. The expenditure in felling is greater by the natural than by the artificial system, because we do not, by the former, as by the latter, cut the whole wood at one time, but come over the same place several times, thereby entailing a heavier cost.

9. When we make use of the artificial mode, we can then cut down the whole, and replant whenever it is considered fit. Were we, on the contrary, to permit nature to perform the task for us, we must then abide her time. In the latter case, the trees must be old enough

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to produce good and sufficient seed to insure a healthy progeny.

10. Lastly, we may mention that, in suitable places, the cleared forest lands might be profitably used for two or three years for husbandry purposes previous to its being replanted.

We draw from the above, in conclusion, that neither of these two systems embraces in itself all advantages, but that a combination of the two is necessary in order to attain the desired end with the least expense and with the greatest advantage. In reality we see the natural system of rearing woods only there exclusively employed where either very favourable positions fully insure the success, or to remain in large extended forests is of scarcely any value, and therefore the rearing of regular and complete young offspring is not absolutely desired. On the other side, the artificial system is only then in exclusive use, where by this means a valuable by-revenue can thus be insured, such as the usage of the ground for husbandry purposes, the obtaining of grass and food for cattle, &c., or where natural hindrances are alone by this means to be surmounted.

The manner in which the above systems are to be combined, in order to meet the object in view, is different according to the various exposures and kinds of trees, and is more or less modified by the designs and ends of the proprietor.

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XVI.—*ON THE DISTRIBUTION OF THE PRINCIPAL TIMBER TREES OF INDIA, AND THE PROGRESS OF FOREST CONSERVANCY.*

[Abstract of Paper read at the British Association—Norwich, 1868.]

BY DR H. CLEGHORN.

WHEN the British Association met at Edinburgh in 1850, a committee* was appointed to consider "the probable effects, in an economical and physical point of view, of the destruction of tropical forests." Their report was presented in 1851 at Ipswich. Attention was thus directed in India to the importance of preserving every influence which tends to maintain an equilibrium of temperature and humidity, of preventing the waste of valuable material, and the special application to their various uses of the indigenous timbers of the country.

A few years later forest establishments were sanctioned in British Burmah (1855), and in the Madras Presidency (1856); and in 1864 Government laid the foundation of an improved general system of forest administration for the whole Indian Empire, having for its object the conservation of State forests, and the development of this source of national wealth.

The executive arrangements were left to the local administrations, general principles being laid down, the most important of which is, that all superior Government forests are reserved and made inalienable, their boundaries marked out to distinguish them from waste lands available for the public. Act 7 of 1864, defining the nature of forest rules and penalties, has been adopted by most of the local governments.

Valuation surveys have been made to obtain reliable data as to the geographic distribution of the more valuable trees, the rate of growth, and the normal yield of the forests.

Bengal.—In British Sikkim and the Dooars of Bootan there are large tracts of Sal forests not yet surveyed. The produce of these forests is required for any extension of the Eastern Bengal Railway which may be determined upon, and for the doubling of the East India line now in progress. In the Darjiling district the higher slopes above 6000 feet have been reserved, and plantations, both of temperate and subtropical trees, have been formed. In the Terai several thousand Mahogany trees have been planted out—raised partly from seed naturalised at the Calcutta Botanic Garden, and partly from seed received from the West Indies, through the Colonial Office and Dr Hooker. In Bengal the department had for two years the great advantage of Dr Thomas Anderson's superintendence, whose botanical knowledge was of special value in the exploration of the little-known forests of Sikkim and Bootan.

North-West Provinces.—The recent surveys have added much to our knowledge of the North-West provinces. In Kumaon and Gurhwal the area surveyed is about 400,000 acres; a large part of this is covered with Pinus longifolia, bearing an average of fifteen trees per acre. The Himalayan Box is plentiful in certain localities, and has come into use in the schools of art for wood engraving. The Goruckpore forests cover 120,000 acres, and consist mainly of Sal (Vatica robusta), with an average of twenty-five well-grown trees to the acre.

The northern limit of indigenous Teak is in Bundlekhund; it has been planted in the Punjab, but in that dry climate it is poor and stunted. The management of the forests of the North-West provinces is second in importance only to that of Burmah.

Oudh.—From the survey in Oudh it ap-

* The late Dr Forbes Royle, King's College, London; the late Colonel R. Baird Smith, R.E.; Colonel Richard Strachey, R.E.; Dr H. Cleghorn, F.L.S.

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pears that more than half of the Government forest consists of Sal; the other reserved woods of greatest value are Sissoo, Toon, and Ebony. Considerable sums have been expended in clearing the Sal trees of destructive twining plants.

Punjab.—In the Punjab the forests growing on the banks of the Five Rivers have been formed into so many ranges under skilled officers, and timber operations have been conducted with more or less success in the intramontane districts. Long leases of the Deodar forests, in the territories of the Rajahs of the Chamba and Bussahir, have been negotiated. Wood is the only fuel at present available in quantity for locomotive purposes. The requirement of the railway alone is estimated at 50,000 tons annually, and the yield of the old shikargahs or fuel reserves, being inadequate, skilled management has been brought to aid in the increased production of fuel.

Selected tracts have been trenched and ploughed before planting, and cattle and camels are strictly excluded. The services of two trained foresters have been secured. The suitability of some Australian trees to the arid plains of the Punjab is remarkable, and several species of Acacia, Casuarina, and Eucalyptus have been tried with apparent success. The northern limit of the Sal is on the bank of the Beas River, in the Kangra Valley, but here it is small and stunted.

Dr J. L. Stewart, the conservator of the Punjab forests, has contributed some valuable papers to the Journal of the Agricultural and Horticultural Society of India, as "Tour in Hazara and Khagan," "Flora of the Peshawur Valley," and "Bijnour and its trees."

Central Provinces.—In the Central Provinces the revenue settlement was proceeding when the forest department was sanctioned, and the demarcation of reserved tracts took place simultaneously, which was a great advantage. Six ranges have been established, and Teak plantations have been commenced on the Taptee and Nerbudda rivers, and are to be steadily pursued on the plan of the Conolly plantations in Malabar. Two trained foresters from Scotland have been employed for some time. The attention of the department in this province is directed equally to Teak and Sal timber. The other reserved woods are Sissoo and Bijasal (Pterocarpus.)

Berar.—Forest operations have been more recently undertaken in the Hyderabad assigned districts. The character of the vegetation resembles that of the Central Provinces, and the same species of trees are reserved. The only Teak tract is at Mailghat, north of Ellichpore, and it is carefully preserved.

Mysore.—The territories of the Rajah of Mysore have always been famous for Sandal-wood and Teak; the former occupies a remarkable belt about 30 or 40 miles inland from the crest of the Ghats, though fine self-sown patches are diffused over the whole tableland. In the adjoining district of Salem, a considerable quantity of Sandal-wood has lately been discovered in the Collamully and Putchamully hills, and two small patches occur in South Canara, but these are at a lower elevation, and the timber is inferior in quality. The western part of Mysore is clothed with fine forest, but much has of late given place to coffee culture.

Burmah.—The progress of forest administration in British Burmah has been steady, with a large increase in the forest revenue. In 1864-5 nine Teak forests were demarcated in the Tharawaddee division; the aggregate area of these is about 50 square miles. The necessity and importance of forming plantations is becoming every year more apparent. A recommendation to plant on a large scale was made 40 years ago by Dr Wallich, and afterwards by Dr Helfer. It was again strongly urged by Sir A. Phayre and Dr Brandis, in their joint report of June 1864, and planting is now systematically carried out. There are now eight Teak plantations, which are being added to by annual increments, and planted in different ways to test the expense which must be incurred in raising Teak on a large scale. The facts recorded in the last report as to the germination of seed from different localities, and the measurement of growth of young trees, are interesting for comparison with the results obtained in Malabar and in

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Java. Further experience in management is annually gained, and it will be ascertained how far the same system is applicable to different provinces.

In Arracan, the most valuable timber tree is the Inga xylocarpa, termed Ironwood from its exceeding hardness. The wood has been found useful for railway sleepers, and is exported to Bengal.

Madras.—The forests of Madras have for twelve years been under the care of a special department. The most valuable timber is Teak, which is to the south of India what Deodar is to the north, and Saluto the central provinces. Energetic efforts are being made to restore the woods in this Presidency, and very extensive plantations are formed, particularly in Malabar and South Canara (Teak), Neilgherries (Eucalyptus and Australian Acacia), Cuddapah (Red Sanders-wood), Shevaroys (Toon and Teak), and Sigur (Sandal-wood). By far the most important of these are the Conolly Teak plantations in Malabar, which are rapidly increasing in value by the growth of the old plantations, and the annual increment of fresh planting. In 1866-7, 120,000 seedlings were planted out. The consumption of wood for railway fuel is enormous, a special train laden with wood for locomotives leaves Coimbatore, and another leaves Cuddapah every day, in addition to the regular trains taking in wood at fuel stations. The natural jungles, which have hitherto supplied this large quantity, are now in some districts so nearly exhausted that the mere protection of those which now exist will not yield a permanent supply. The natural reproduction of the indigenous jungles (where cattle are excluded) is expected to furnish a large supply of fuel, but it is further intended to form plantations for locomotive requirements. These, in accordance with the instructions of the Secretary of State, are to be under the management of the Forest Department, and their cost to be a charge in that department. These operations involve present and prospective outlay, with no returns till after the lapse of seven or eight years. This important branch of forest work must increase with the extension of railways, and it is hoped that the example set by Government may have the effect of stimulating private individuals to form similar plantations. The financial condition of the forest department in Madras is satisfactory. The total net surplus in eleven years, including the value of timber in store on 30th March 1867, is £180,000, or from £15,000 to £20,000 a-year. Within the last few years much has been done in the way of improving forest communications in remote and difficult places..

Bombay.—In the Presidency of Bombay the forest department is of old standing. Mr N. A. Dalzell succeeded Dr Gibson, the first conservator, and is an accomplished botanist. For some years the receipts have exceeded the expenditure by several lakhs, say £30,000 annually. The demarkation of reserves in the Deccan has been in progress, and is a most important measure. The administration of the forests in Scind has received the commendation of Government. The demand for firewood, both in large towns, and for steamboats and railways, has augmented very considerably, shewing the absolute necessity of husbanding the resources, so as to keep up a regular and abundant supply of fuel. The Babool (Acacia arabica) is the tree which thrives best in Scind, and the timber is much prized for many purposes.

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XVII.—*ON THE MANAGEMENT OF EUROPEAN FORESTS.*

A REPORT BY DR H. CLEGHORN, CONSERVATOR OF FORESTS, MADRAS, TO LORD CLINTON, UNDER SECRETARY OF STATE FOR INDIA.

MY LORD,—I have the honour, as directed by you, to report, for the information of H.M. Secretary of State for India, that I left Madras on medical certificate on 27th October last, and reached Malta on 27th November, where domestic circumstances obliged me to remain for three months. During this period, I occupied myself in examining the Islands of Malta and Gozo, and received much cordial assistance from his Excellency Sir Patrick Grant, G.C.B., in my researches as to the physical condition of the islands.

From the absence of water and soil, there are very few trees, and I concur in the truth of Dr Sutherland's remark,* "The great improvement required everywhere, but particularly in the vicinity of the barracks, is shade from trees; this can only be obtained at considerable labour and cost," as the soil consists of a thin covering of earth on soft sandstone. A good beginning has, however, been made in the public gardens of Florian, and several parts of Valletta have been successfully planted with beautiful trees by the late governor, Sir J. Gaspard Le Marchant. The most thriving of these are Pinus pinea, Cupressus sempervirens, Phytolacca dioica, Schinus molle, and Araucaria excelsa.

Among the trees which appeared to thrive best at the Government garden of St. Antonio were several species of Acacia and Eucalyptus from Australia, the same species which have been successfully introduced on the Neilgherry and Pulney Ranges of South India, and which endure the great heat of the Punjab. I had subsequent opportunities of observing the same species flourishing in Sicily and in various parts of Italy from Naples to Genoa; this is an interesting fact in acclimatization. These fine trees are cultivated in the open air, and it was lately suggested in the *Revista Forestale*, a monthly periodical published at Florence, that they might be used with advantage for reforesting the land at the base of the mountains of Sicily and Italy.

The timber for house and boat building in Malta is imported from Trieste and America, and charcoal is supplied from the oak forests at the base of Mount Etna, and sometimes from Greece.

My inquiries at Malta were of a non-official character; but before leaving I placed in the hands of Sir Victor Houlton, Chief Secretary to Government, letters to Major Beddome, my deputy in Madras, and to Dr F. Muller, Director of the Gardens, Melbourne, in which supplies of seeds were solicited, and a system of reciprocal interchange proposed. It will probably be best to obtain seed direct from Australia, as all that is collected in India is at present required for the railway fuel plantations.

I have also consulted Dr Hooker, Director Royal Gardens, Kew, as to his ability to supply select trees for this Mediterranean station, and he has expressed his readiness, with the sanction of the First Commissioner of Her Majesty's Works, to give any assistance within his jurisdiction.

From Malta I proceeded to Sicily, and saw the Botanical Gardens at Catania, Messina, and Palermo. Near the last city, I visited an interesting school of agriculture, where the cultivation of Sumach, and other economic plants, was being carried on. Colonel Yule, C.B., has kindly translated, at my request, a treatise on the cultivation of this useful tree,

* See an admirable account of the topography of Malta in his Report of the Sanitary Condition of the Mediterranean Stations, Part II., 1863.

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(Rhus coriaria), which has been read at the Botanical Society of Edinburgh, and will appear in the *Transactions*.* I would venture to recommend that the paper be circulated in the Punjab and other parts of India, where several species of Rhus grow.

The following figures, obtained at the Custom House, shew the export of Sumach from Palermo on which duty was paid in 1867 :—

Sumach in leaf, kilogrammes 2,323,130, or, say, tons 2,282.

Sumach ground, kilogrammes 15,692,699, or say, tons 15,413.

The climate of Palermo appears to be favourable for maturing seeds of many plants grown in North India, and an interchange of plants and seeds has been initiated with the Calcutta Garden; two large cases from Dr Anderson arrived while I was there. It occurs to me that it might be advantageous to the horticultural societies of India to obtain their supplies of seed from a dry climate, nearly in the same parallel of latitude with the Punjab.

The state of the roads in Sicily is not favourable for transporting the timber from the pine and oak forests which clothe the slopes of Mount Etna. Firewood and charcoal are brought down in large quantities on the backs of mules for the supply of Malta and the adjoining islands.

Vast herds of cattle and goats pasture at certain seasons in these forests, and there is a brisk trade in carob beans, almonds, hazel nuts, walnuts, chestnuts, and other forest produce, yielding an annual revenue. Oranges, citrons, and mulberries are very extensively cultivated. Olives and prunes are planted at regular distances on the steep declivities, and bind the soil together with their roots. The climate permits of shady trees being freely introduced in land occupied for agricultural purposes.

In Sicily and Calabria there is a great extent of the manna ash tree (Fraxinus ornus). The following statement, abstracted from the returns in the British Consular Office, shews the value of the drug exported during the last four years :—

——	U. S.	Baltic	France	Great Britain and Colonies.	Italy	Other Countries.	Total
	£	£	£	£	£	£	£
1863	758	368	2,593	9,841	—	3,377	16,937
1864	1,377	1,500	4,446	10,048	100	5,259	22,720
1865	3,514	500	2,141	4,257	200	2,200	12,812
1866	4,076	1,500	2,384	4,354	300	2,258	14,875

The merchants concur in saying that the demand is falling off.

In Florence, by the kindness of the Hon. Mr Marsh, Plenipotentiary of the United States, and of Signor Filippo Parlatore, Professor of Botany in the Imperial University, I obtained a copy of the *Manuale Teorico-pratico d'Arte Forestale*, 1864, now used by all the forest officers in the kingdom of Italy, and also the *Compendium of Forest Regulations*, published by the Minister of Agriculture in 1866. A careful study of these books shews that though less attention has been given to sylviculture and to forest legislation in Italy than in France and Germany, yet the scarcity of constructive material, and the destructive action of torrents, have aroused the attention of the Government, and the importance of a sound system of forest management is now as clearly recognised in Italy as in neighbouring countries.

Many landed proprietors, including Baron Ricasoli, are planting successfully, though not forming forests on an extensive scale; and discussion has taken place in the Chamber of Deputies as to the replanting of denuded mountain tracts in Alpine Italy. The union of the Italian petty States under one government has rendered practicable the arrangements for conserving and restoring its unexhausted forests, but the state of the kingdom is not yet favourable for steady progress in this branch of legislation.

It may be noted that a monthly periodical has been published for six years, which contains many interesting contributions on sylviculture, and the *Bibliographia Italiana* com-

* Vol. ix. p. 349.

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prises, among many others, the following recent works, which are specially worthy of perusal :—

Caimi, P. Memorie sull importanza e coltura die Boschi.—(Milano, 1857, 8vo.)

Cerini, G. Dei vantaggi che apporterebbe allo Stato ed alla condizione idraulica dei territorj l'instituzione di Società per l'impianto e conservazione dei Boschi.—(Milano, 1844. 8vo.)

Meguescher, F. Memorie sulla migliore manièra per rimettere i Boschi della Lombardia, &c.—(Milano, 1859. 8vo.)

An Italian edition of "Man and Nature," by the Hon. G. P. Marsh, is now in the press, containing an excellent account of all that is being done to improve the Maremma of Tuscany, and giving the history of the legislation of the former Republics of Venice and Genoa for protecting the forests of the Appenine and Maritime Alps.

I made the acquaintance of several Italian botanists and forest officers,* with whom a profitable intercourse may be kept up hereafter.

In Switzerland I had an opportunity of seeing the spring operations on the borders of the Lake of Geneva, where felling was being carried on, and pine logs are stored in large quantity; these are brought down from almost inaccessible positions by various mountain torrents. When the snow melts and the flushes commence, the logs are launched without loss of time, as in the intramontane districts of the Himalayas. The moving and sliding of the timber and the floating operations are very instructive.

The wooded crests and high forests overhanging cultivated valleys are strictly preserved, they serve as "boulevards" against avalanches and cataclasms; and this preservation has been found to be equally necessary in the deep chasm valleys of the North-West Himalayas.

The communal woods around Berne and Geneva are treated with great care, but are not so rigidly and economically conserved as the State Forests in France and Germany.

In passing through France, I took the opportunity of seeing as much as possible of the Forest administration between Bâle and Nancy. At Nancy I spent six days, and had several conferences with Professor Henri Nanquette, Director of the Imperial School of Forestry, with M. Matthieu, sub-director, and the other professors, who explained fully the system of training.

The institution was founded in 1824, and the buildings are now being reconstructed and enlarged. The students, eighty in number, live in the school, except the ten foreign pupils, "externes :"—

British . . .	5
Belgian . . .	2
Portuguese . .	2
Swiss . . .	1
	10

who have private lodgings close by. All are under strict discipline, and, except in the wearing of uniform, the foreign pupils conform to all the rules, of which there has been no infraction on the part of any of our young men. The director spoke in a kindly manner of them, and with much satisfaction,* and said that they were fond of the work; on the other hand, they are happy and contented, and allude to the "bonté," shewn them by the director and the professors.

In the general register of the "Ecole Forestière," the stipendiary students intended for India occupy a fair position.

Mr Pengelly stands the ninth in the whole school, which, considering that he has been studying in a foreign language, must be considered very good. From the reports of M. Nanquette, as well as from personal intercourse with the young men themselves, at Nancy, I feel sure that one and all will prove useful assistants.

I have derived great pleasure from seeing the French system of culture of woods, and the general management of large tracts of

* Professors Toruabene, Catania; Todare, Palermo; Inzènga, Palermo; Cesati, Naples, Pasquali, Naples; and F. Parlatore, Florence.

* "Bien satisfait."

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forest, as it is practised in that empire. The different features of the aboriginal woods present many points of analogy with the forests of Northern India; and it is instructive to note the careful investigation of the relation of the wooded surface to the water supply.

The manuals prepared for the use of the Forest School are specific in their details, and are in every sense practical handbooks. We have not at present a sufficient stock of facts for the compilation of a Forest Manual for India, but the time is approaching when similar guides may be prepared with much benefit to the department.

The only point in the training of the pupils to which I would draw attention is the Forest Code of France. The processes as to trespass, and other forest offences, are very different from the provisions of the Indian penal code, or the Forest Acts which have been passed by the local governments and administrations.

Although the pupils cannot fail to derive benefit from the precise rules laid down, and from the habit of watching the cases tried, yet it appears to me that the French rules which are inculcated are more stringent than it would be desirable, or perhaps practicable, to introduce into India, where it is often difficult to obtain a conviction for forest offences under the mild provisions of the Indian Forest Act.—I have the honour to be your Lordship's obedient servant,

H. CLEGHORN, M.D.,
Conservator of Forests, Madras,
On Leave to Europe.

The LORD CLINTON,
Under Secretary of State for India.

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APPENDIX (A).

LIST OF MEMBERS

CORRECTED TO MARCH 1869.

** *Honorary Members.* * *Life Members.*

† *Members who have doubled their Subscriptions for the current year, in order to form a Capital or Sinking Fund.*

All Subscriptions payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrear are not entitled to receive the Transactions.

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ANDERSON, James, Meadowbank, Uddingston
ANDERSON, John, Newstead Abbey, Nottingham
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†BALDEN, Peter G., Forester, Vynhol, Bangor, North Wales
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†BARRIE, James, Assistant-Forester, Cullen House, Cullen
BATY, William, Forester, Netherby, Longtown
BEGBIE, Harker, Forester, Castle Menzies, Aberfeldy
BELL, James, Strathfieldsaye, Winchfield, Hants

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M'Lean, William, Forester, Eglinton Castle, Irvine
M'Lellan, Duncan, Superintendent of Parks, Glasgow
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M'Neill, D., Timber Agent, Kirriemuir
†M'Queen, Alexander, Forester, Castle Grant, Grantown
M'Rae, John, Assistant-Forester, Hamilton Palace, Hamilton
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†Marshall, J., Forester, Lambton Park, Fence Houses, Durham
Martin, George, Forester, Dunecht House, Aberdeen
Martin & Sons, Messrs, Nurserymen, Cottingham, Hull
Melrose, John, Forester, Crathes Castle, Aberdeen
Melrose, William, Forester, Byram Hall, South Mitford
Menzies, William, Forester, Tealing, Dundee
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†RAVENSCROFT, Edward, India Buildings, Edinburgh
†REID, George, Nursery and Seedsman, Aberdeen
†RICHARDSON, Alexander, Land-Steward, Arniston, Gorebridge
RINTOUL, Henry, Dupplin Castle, Perth
RITCHIE, Henry, Messrs P. Lawson & Son's Nursery
†RITCHIE, Walter, Forester, Dinas Mawddwy, Shrewsbury, N. Wales
ROBERTSON, Alexander, Land-Steward, Powerscourt, Enniskerry
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh
ROBERTSON, James
ROBERTSON, John, Garryland House, Gort, County Wicklow
ROBERTSON, John, Forester, Minto House, Hawick
ROBERTSON, Peter, Land-Steward, Foulis Easter, Dundee
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh
ROBERTSON, Thomas, Forester, Donnington Park, Derby
†ROBSON, Alexander, Forester, Glenalmond, Perth
ROBSON, David, Assistant-Forester, Glenalmond, Perth
†RUSSELL, John, Craigie, Ayr
†RUTHERFORD, Andrew, Forester, Bowmont Forest, Kelso
†RUTHERFORD, James, Forester, Linthaugh, Jedburgh
†RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire
RUTHERFORD, Robert, Assistant-Forester, Altyre, Forres

†SADLER, John, F.R.P.S., Experimental Cottage, Edinburgh.—*Secretary*
†SAMSON, John, Forester, Abernethy, Strathspey
†SANDBACH, Henry R., Esq., Hafodunos, Llanrwst, Denbighshire
SCOTT, Andrew, Assistant-Forester, Newton Don, Kelso

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†Scott, D., Assistant-Forester, Penrhyn Castle, Bangor, N. Wales
†Scott, David, Assistant-Forester, Duthill, Strathspey
Scott, John, Forester, Fotheringham, Forfar
†Scott, John W., Esq., Delgany, County Wicklow, Ireland
Scott, Walter, Forester, Oxnam, Jedburgh
†Scrymgeour, William, Assistant-Forester, Scone, Perth
†Simpson, J., Forester, Alloa Park, Alloa
†Simpson, Thomas, Forester, Wolfelee, Hawick
Skirving, Archibald, Forester
Skirving, William, Nursery and Seedsman, Liverpool
†Slater, A., Forester, Gartmore, Stirling
Slater, A., jun., Assistant-Forester, Culzean Castle, Maybole
†Smart, A. H., Forester, Drumpellier, Coatbridge
†Smith, James, Forester, Donibristle, Aberdour, Fife
Smith & Simons, Messrs, Nursery and Seedsmen, 1 Buchanan Street, Glasgow
†Smith & Son, Messrs William, Nurserymen, Aberdeen
Solly, Professor Edward, F.R.S., Parkstone, near Poole
Sommerville, Samuel, M.D., 17 Hart Street, Edinburgh
†Spence, William, Assistant-Forester, Airlie Castle, Kirriemuir
Stapylton, Major, Myton Hall, Borobridge, Yorkshire
Stark, Robert M., Woodbine Cottage, Trinity, Edinburgh
Steele, David, Forester, Skene House, Aberdeen
†Stevenson, James, Forester, Cobham Park, Surrey
Stewart, Alexander, Chancelot House, Ferry Road, Edinburgh
Stewart, William, Land-Steward, Dalhousie Castle, Lasswade
Stewart, William, Forester, Ballindalloch Castle, Craigellachie
†Stuart, Lewis A. G., Assistant-Forester, Cullen House, Cullen
Stuart and Mein, Messrs, Nurserymen, Kelso
Syme, David, Bangholm House, Edinburgh

†Talbert, Peter, Forester, Glenericht, Blairgowrie
Taylor, George, Forester, Monymusk, Aberdeenshire
Taylor, George, Nursery and Seedsman, Inverurie
Thomson, James Scott, Castle Strathallan, Auchterarder
Thomson, John, Forester, Mount-Stewart, Rothesay
†Thomson, John Grant, Forester, Grantown, Strathspey
†Thomson, William, Deputy-Surveyor, Chopwell Woods, Burnopfield, Durham
Tivendale, William, Forester, Houston, near Paisley
Tweedie, John, Forester, Dunglass, Cockburnspath, Berwickshire.

†Ward, James, Assistant-Forester, Powerscourt, Enniskerry
Waterer & Godfrey, Messrs, Nurserymen, Knaphill, Surrey
Weaver, James, Forester to the Marquis of Lothian, Mount-Teviot, Jedburgh
†Weaver, James V., Forester, Cortachy Castle, Kirriemuir
†Welsh, James, Nursery and Seedsman, Edinburgh
Welsh, John, Assistant-Forester, Mount-Teviot, Jedburgh
†Welsh, William M., Nursery and Seedsman, Edinburgh
†Whiteford, Robert, Assistant-Hedger, Bute Estate, Rothesay
Wilson, John, F.R.S.E., Professor of Agriculture, University of Edinburgh
†Wilson, Robert, Forester, Everleigh, Marlborough
Wilson, Stephen, 132 Union Street, Aberdeen
Wood, James, Factor, Haighall, Lancashire
Wood, John, Gardener, Hatton Castle, Aberdeenshire
†Wylie, George, Assistant-Forester, Cullen House, Cullen

Yellowlees, George, Wood Merchant, Galashiels
Young, John, Messrs Imrie & Sons' Nurseries, Ayr
Young, William, Assistant-Secretary, Royal Caledonian Horticultural Society, Edinburgh

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Applications from gentlemen desirous of becoming Members of the Society to be addressed to Mr JOHN SADLER, Secretary, Royal Botanic Garden, Edinburgh, from whom the Society's Transactions, Copies of the Laws, and all other information, may be obtained.

All Subscriptions and Communications relative to the Society's Financial Affairs to be forwarded direct to Mr JOHN ANDERSON, Nurseryman, Perth, the Treasurer, and *not through* the Secretary.

Members in arrears will not receive their Transactions, and are therefore requested to obtain their receipts from the Treasurer without further delay.

Members are requested to notify to the Secretary any change in their Address.

Abstract of the Laws of the Scottish Arboricultural Society, as amended to 4th November 1868.

The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical Operations of Forestry, and publication of the same; and by such other means as may be found advisable.

The Society shall consist of the following classes of Members:—1. Proprietors and others, paying an Annual Subscription of Half-a-Guinea; 2. Factors, Nurserymen, and others, paying an Annual Subscription of Five Shillings; 3. Head-Foresters, paying an Annual Subscription of Three Shillings; 4. Assistant-Foresters, paying an Annual Subscription of Two Shillings.

Any Member may become a Life-Member by compounding for his Annual Subscriptions by a single payment; those of the First Class paying Five Guineas; those of the Second Class, Three Guineas; and those of the Third and Fourth Classes, Two Guineas.

The Society shall elect a limited number of Honorary Members,—gentlemen who have acquired eminence in the science of Arboriculture, or who are otherwise deemed worthy.

All Annual Subscriptions shall be payable in advance, at the term of Martinmas, yearly.

In addition to the Annual Subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his Annual Subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member, shall be held responsible for the first year's subscription of such party.

The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and a Committee of fifteen Members,—these office-bearers to be elected annually at the General Meeting in November; the three Members of Committee at the top of the list to go out annually, but one to be eligible for re-election.

A General Meeting of the Members shall be held on the first Wednesday of November annually, for the election of New Members, the appointment of Office-Bearers, the reading of Papers, awarding of Prizes, and other business.

JOHN SADLER, *Secretary.*

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APPENDIX (B).

GENERAL ABSTRACT OF THE ACCOUNTS OF THE SCOTTISH ARBORICULTURAL SOCIETY FOR 1867-8.

CHARGE.				DISCHARGE.			
1. To Subscriptions for 1867-68	£50	15	0	1. By Cash due Treasurer .	£7	19	8
2. „ „ Arrears .	8	1	0	2. „ „ paid for Engraving	0	10	0
3. „ Sale of Transactions .	0	8	0	3. „ „ „ Stationery	1	10	0
				4. „ „ „ Prizes .	2	2	0
				5. „ „ „ into Savings Bank	28	19	0
				6. „ „ „ Secretary's Salary	10	0	0
				7. „ „ „ „ Postages, &c., as per Statement	5	19	8
				8. By Cash paid Treasurer, Postages, and Petty Charges .	1	12	6
				9. Balance in Treasurer's hands	0	11	2
	£59	4	0		£59	4	0

I have examined the Books and Vouchers, and found them correct.

(Signed) THOMAS METHVEN, *Auditor.*

EDINBURGH, *4th Nov.* 1868.

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XVIII.—ADDRESS DELIVERED AT THE SIXTEENTH ANNUAL GENERAL MEETING.

BY ROBERT HUTCHISON, ESQ., OF CARLOWRIE, PRESIDENT.

BEFORE beginning the business of another year, you must allow me, first of all, to thank you sincerely for the honour you have done me, in re-electing me, for the fifth time, President of the Scottish Arboricultural Society. I feel proud, indeed, of this mark of your confidence, and it will be my most earnest endeavour to continue to advance to the utmost of my ability, the interests and prosperity of this Society. I have also, in name of the General Committee, to thank you each, individually, for the exertions you have made for the furtherance of the objects of the Society during the past year. The roll of membership, through these endeavours, has largely increased; and I am happy to observe that the number of communications upon various Arboricultural topics of interest, sent in to the Secretary, as well as the number of essays and reports lodged this year for competition, is also considerably above that of former years. These, I trust, are indications of your increasing interest in the welfare of the Society, and of the growing consciousness among practical men throughout the country generally, of the importance of Arboriculture, and of cultivating a knowledge of it, as a science, intelligently. Without this knowledge, and the habit acquired, by a careful training of the mind, of observing the phenomena of nature which come under our notice, there is little hope for the foresters of the present day advancing in the race of progress, which is now happily so general in this country;—and, gentlemen, this observation of the wonderful phenomena of the physical world must be not simply to treat them as mere isolated facts, but as parts of a system whose laws can only be understood by careful observation of facts, and a process of deductive reasoning from these facts to general laws. In the present day, when the minds of scientific men are excited and unsettled by a number of new theories, and when, at the same time, there is a growing conviction that knowledge is not various but *one*, and that all the different kingdoms of nature form parts of one harmonious whole, so that all who study nature in any of her aspects or fields, are labourers in one great cause, there is a great and growing need of a careful observation and registration of facts. We may not all be able to generalize, but we can all observe, and it is from a large and accurate body of ascertained phenomena that general laws will be deduced, and the truth or falsehood of theories will be determined. As an Association, we are in very favourable circumstances for aiding in this great work. The lives of most of our members are spent amongst some of the most beautiful and interesting of nature's handiworks; and from education and habit, foresters in Scotland are eminently well qualified for taking a practical and intelligent view of the phenomena which come under their notice; and it is only by close, and patient, and painstaking watching of facts that the battle which is now raging so hotly over the development theory can be determined. But, gentlemen, there is also another and more practical cause in which we are called upon to assist, and that is, in endeavouring to ascertain exactly the influence which vegetation has, or rather the influence which *woods* exert on the health of the country, both directly and indirectly, through their bearing on the rainfall. This is a most important and most interesting branch of Arboricultural science, and one which is yet completely in its infancy. The attention of scientific men has only lately been aroused to the fact, that trees modify very materially both the climate and the rainfall of a country; and in order to ascertain the precise nature and extent of the influence

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they exercise, very minute and careful observations, and a series of registrations in different localities, under different circumstances, must be made. This is a work which falls very particularly within our immediate province as a Society, and we must not shirk it, but must each one carefully, and conscientiously, do the portion of it which falls to his hand to do; and by all labouring together, an immense amount of light may be thrown on this important question, which may be useful to the more purely scientific minds and associations; and should we, in our humble investigations, aid thereby in defining laws by which our country will be benefited, both in the increased health of its inhabitants and in the improved abundance of its harvests, the reward of the pains and trouble expended will be a rich one. But, gentlemen, besides the good we may help, by God's blessing, in doing to our countrymen, we shall certainly be conferring a great boon on ourselves by cultivating a habit of intelligent observation. We cease to be like "dumb driven cattle," and become "heroes in the strife," when we lift our daily work out of the mere routine of petty drudgery, into willing co-operation in the great battle of knowledge against ignorance; and every day, as we go on striving, the field of our view will open up and enlarge, and we will find an intensified interest in our lives, and in everything that surrounds us. The dignity and importance of Arboriculture as a science, is, at last, I am happy to say, forcing itself upon public attention, and the work of the forester is making itself felt as an agency of immense power for good or for evil, according as it is performed. Unfortunately, in former years, from ignorance of climatic and hygienic laws, which are now acknowledged, forestry was regarded as mainly a necessary work of destruction. This is now authoritatively admitted and referred to by the Under-Secretary of State for India—Mr Grant Duff—who, in introducing his financial statement in the House of Commons, in the last session of Parliament said (referring to Indian Forest Conservancy)—"No one who had not looked into this subject, had the faintest idea how terrible were the effects over wide regions of the globe, of carelessness in not keeping up a proper proportion of trees. Let any one to whom the whole matter was new, turn to the remarkable work of the American Minister at Florence, Mr Marsh, upon 'Physical Geography as Modified by Human Action,' and he will shudder at the dangers which we have only just escaped. If our predecessors in India had known what we know, much of the enormous expense which we are now being put to with regard to irrigation would have been quite unnecessary. But the mistakes of former days are past praying for, and we can only now rejoice that the conservation of the forest has been recognized as a great State necessity, and that a regular forest department has been inaugurated, which will take to India the science of France and Germany." Now, gentlemen, with regard to this speech of the Indian Secretary, I have a remark to make. The schools of forestry in these countries are famous, and deservedly so; but I am proud to say that, in my humble opinion, Scotland, without any school of forestry, is equally famous in this department. And one of the necessary qualifications, in fact, *the* concluding touch to the education of those young foresters, who are, according to Mr Grant Duff, "to carry to the East the science of France and Germany," is, that they must for a time, after being in France and Germany, have studied under some approved *Scotch* forester in Scotland—to rectify, I suppose, any erroneous ideas imbibed in France and Germany previously. Yes, gentlemen, in the ranks of this Society, there have been found many scientific foresters, who have been chosen by the Government, and sent forth to our Indian empire; and at the present moment, if I am not mistaken, two young men —members of the Scottish Arboricultural Society—are about to follow these pioneers, who have carried the name of our Society to the jungle and the Himalayan peaks, and who are already shewing that Scotch energy and shrewdness are not unequal to grapple with the difficult problem of the conservancy of the Indian forests. Let us, then, gentlemen, endeavour to distinguish ourselves in such a

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way as a Society, by scientific forestry and progress in the van of Arboriculture, that ere long the fact of membership in the Scottish Arboricultural Society will be a *sine qua non* for a Government appointment to the Indian forests; and let our ranks be the source to which not only our own Government, but that of other countries, will look for the best and most advanced foresters. But, gentlemen, to attain such a position, we must labour hard in the work of self-education, ever bearing in mind that the best, and indeed the only true education, is that which a man gives himself by training his mind to habits of close and accurate observation, and by accustoming himself to classify and arrange the facts he has ascertained by careful watching, and reasoning from these facts to general principles and laws. And let us never forget, gentlemen, the proverbial quality of our country, *caution*. We must be quite sure that our theories are based upon facts, and not our facts on theories. The rock on which many scientific men have struck is theorizing first, and observing afterwards; and so twisting and perverting facts to suit pre-conceived notions. And we must not be discouraged if, at first, in our investigations into any department of nature, it appears "a mighty maze and quite without a plan." If we only persevere, light will begin to dawn through the darkness, and order to emerge from what we had thought was chaos—the facts which at first sight presented a mere jumble of discordant and contradictory matter, will group and arrange themselves into order, and we will be rewarded by understanding the method, and beautiful reason of Nature's workmanship, and of feeling that we can aid in modifying his effects to suit the wants and requirements of the human race. In cultivating Arboriculture in a scientific spirit, we will also find our interest in every other field of knowledge and inquiry awakened and excited; for, as I before remarked, all knowledge is one, and as Arboriculture influences climate and rainfall, these again influence the productiveness of the soil, and the health of man and beast, and from these spring, in endless ramifications, all the other branches of industry and knowledge; so in first labouring earnestly and sincerely in our own calling, we will find ourselves made freemen of the great world of science and art.

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XIX.—*ON THE INFLUENCE OF ARBORICULTURE.*

BY ANDREW GILCHRIST, FORESTER, URY HOUSE, STONEHAVEN.

TREES are the noblest product of the soil. They not only ameliorate our climate, fertilize the soil, variegate and adorn the earth, but they are at all times and in all places full of interest; whether we wander amongst them in some fine lawn in front of a noble mansion, and contemplate the magnificence of their noble trunks and massive far-spreading limbs, and the many gorgeous tints and hues of their varied and exuberant foliage, or ascend some elevated spot, and seated beneath their leafy shade, obtain a peep across the wooded valley; it may be at some beautiful lake spread out like a sheet of glass before us, studded here and there with islands, whose craggy surface is clothed with the beautiful birch, or the majestic pine;—or seated beneath their ambrosial shade, the peep obtained may be at some plantation in the distance, planted on a cold bleak moor. Contrasted with the surrounding bare hill side what freshness and luxuriance there is in the vicinity, and more especially within the influence of woodlands! Far out beyond the shelter and influence of the mass of trees, how very bleak and inhospitable the tract of moorland appears! To what cold blasts the animals that graze on it must be exposed! But the nearer we approach to the plantation the appearance of the bare hillside becomes more inviting, and when fairly within its kindly influence, the bleak aspect is changed into one of fertility, beauty, and verdure. The coarse unnutritious grasses, and brown heath succumbing to the influence of Arboriculture quit the soil, and leave it covered with a more verdant and succulent crop of pasture. Other portions of this tract of land also under the influence of the trees, may have been trenched and drained, and be occupied by various kinds of crops, the result of the energy and skill of some industrious and enterprising agriculturist, who becoming convinced that there is a beneficial influence in trees for both stock and crops, has taken a hint from Nature, and assists her in still further developing what she began. Nature can plant both fruit and forest trees, sow grasses, and grow many other good and useful plants, but grains, such as oats, wheat, and barley, are found nowhere growing in a wild state, but being unable to exist by self-sowing, they entirely disappear from every country which man leaves wholly to Nature. While man has thus by skill and art rendered large districts of our country fit for the growth of cereals, Arboriculture has by her influence sheltered and protected these crops from the violent storms that were wont to blow with such fury over the formerly treeless waste.

Thus, whether we contemplate the attractive beauty, or the beneficial influence of trees, there is a grandeur and a power about them; and surely we cannot fail to see that one of the objects for which the bountiful Creator made them was, that they might be an essential element in the amelioration of our climate, and by their influence render it more congenial, alike for animal and plant.

> "These are thy glorious works—Parent of good!
> Almighty! thine this universal frame.
> Thus wondrous fair; Thyself how wondrous then!"

If it were impartially and judicially examined, the influence of Arboriculture would be found to be one of those important subsidiary rills which has done much to swell the rivers of success that have attended the efforts which have been put forth by agriculturists generally to improve and fertilize the soil. Doubtless many persons are still unacquainted with the importance of judiciously managed plantations on agricultural lands. Arboriculturists indeed have themselves to

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blame for this, seeing they have displayed little energy in informing the public of the beneficial effects arising from planting in many localities. This indifference on their part is unquestionably doing much to retard the progress of Arboriculture; for if the public were better informed on the expediency of planting, and if they knew more of the advantageous effects of trees, they would naturally be more ready to lend us their assistance to obtain for Arboriculture recognition as one of the exact sciences. And in these days when our indefatigable President and other energetic and persevering members, by attending the meetings of the British Association, and otherwise, are doing what they can to advocate the claims of Arboriculture as a science; it would be of no small importance to have a little more assistance from the general public; and that we may the more readily get such help in the furtherance of this important object, let us individually do what we can to inform the public mind how much trees conduce to the improvement of the soil and climate. The great book of Nature is always spread out before us, and if we only look at it aright we cannot fail to become acquainted with many facts that are well worthy of being observed and recorded. There is not a single member of our Society, who could not furnish some item of interesting and useful information regarding the beneficial effects of the influence of trees in the particular district where he is situated. How the general treasury of Arboricultural knowledge would be enriched if each one of us, laying aside his indifference, would with willing heart, cast in his mite of experience and observations. A mere superficial and abstract inquiry into causes in any one quarter is not sufficient, the information must be drawn from various stations, from districts where it is quite evident that there is an abundance of trees, as well as from those where trees are almost entirely absent. With so many labourers gathering information from such a diversity of soils and situations, an enormous amount of good would be attained by contrasting the one situation with the other.

In fact, there is an evident danger in remaining in ignorance of the influence of trees, for they do in no small degree contribute to the production of our food (as was so ably shewn by Mr William Brown in his excellent papers on "Trees and Climate"), and to a great extent they have made the climate of Scotland what it now is. If we fail, therefore, to acquaint ourselves with a knowledge of the influence of trees, we not only run the risk of losing the benefits of their influence, but at the same time we are exposing ourselves to the injuries which their entire absence or sudden removal is capable of producing.

It is a well-known fact that many of our agriculturists are slow to acknowledge the benefits of Arboriculture; and instead of appreciating its influence they receive any statement made in its favour with incredulity; and indeed not a few of them sneer at the presence of plantations near their farms as being more likely to produce an excessive stock of vermin, than to aid them in realizing an abundant crop in harvest. It is needless for us to enter into any argument against the popular idea among the farming community, that the formation of plantations brings rabbits to a district. If we were to do so we would only say that the destruction of weasels and other operations of gamekeepers do more for the increase of rabbits than plantations do. And we are quite certain that the high degree of good that all kinds of crops derive from the proximity of plantations far more than compensates for any little injury that may be sustained.

To be thoroughly impressed with the paramount importance of shelter, as derived from Arboriculture, let us examine a field that is only partially under its influence. Beginning our observations at a portion of the field beyond the influence of the trees we find only a very meagre crop, but the more we come within the range of its influence, we find that the corn becomes taller and the head much heavier. Consequently, that which is sheltered yields a greater quantity, and a much finer quality of grain. This is the case also in regard to either a crop of grass or turnips. If they are grown with suitable shelter there is a larger produce, and their feeding quali-

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ties are increased to a greater degree. Indeed the difference between a sheltered and an unsheltered crop is so great, and shews so plainly how very effectually the influence of plantations promotes the growth of all kinds of crops, that even the most uninitiated (if he approach the matter impartially) cannot fail to become convinced that shelter is a powerful agent, and that if plantations are judiciously placed they will greatly help to develop the resources of every description of land. Although the range of its influence is much more limited, the effects of shelter may be observed on a field which is protected by a high wall; or, as is frequently seen, the conformation of the land provides a certain amount of shelter, by the hills with which it is intersected, breaking to some extent the force of the wind. If a crop of corn is examined in such a situation, it will generally be found strongest and most luxuriant where it grows within the influence of the shelter of the hills; while beyond, where the force of the blast is unbroken, the crop gradually becomes shorter and thinner, yielding an inferior quantity and quality of grain.

If, therefore, the shelter derived from a hill, or even a stone wall, tends to promote an increase of crop, how much more valuable must the shelter produced by the proximity of plantations be, whose beneficial influence extends over a far wider range? Moreover, a mass, or even a belt, of timber affords more shelter than any hillside, for plantations not only break its force, but they, as it were, *absorb* the wind, and cause it to percolate through among the trees. It is thus deprived of its force, and entirely prevented from eddying; whereas a hill completely obstructs the course of the gale, and, consequently, produces an eddying current so destructive in laying grain crops. Besides, when the passage of the wind is thus resisted by a hill, it generally takes a direction similar to the form of the hill, and its force is not lessened to any extent, but sweeps along the plain with as great if not with greater fury. It is in consequence of this that shelter from a hill does not extend over the same area as shelter derived from plantations. A mass of trees may be said to soften the wind, and cause it to fall mildly on the adjoining fields. Therefore it is that the shelter supplied to crops and stock from plantations is superior in every respect to any natural or artificial erection or eminence.

Mr John Lockart Morton, the eminent civil and agricultural engineer, says—"It is well known to practical men, that without shelter, crops grown even on the richest land, generally prove deceptive in the yield. To the unpractised eye they may appear of superior quality; but, except in pet seasons, they never stand the miller's test. Take, for example, one of our cold moorland districts where a crop out of every five or six is frosted, and where even the best harvest is far from being remunerative to the farmer. When suitable hedges are formed in such a locality, sheltering strips of wood planted and properly managed, the productiveness of the soil will soon be greatly increased. A field of cereals exposed on the one side to an extensive unhedged moor, and sheltered on the other by enclosed fields, uniformly sustains the severest injury from winds and frosts on the open side. Often, too, in fields infested with wire and grub worms, from 10 to 15 yards next an ordinary-sized hedge running transversely to the wind, will be found comparatively unharmed. An advantage so very palpable is certainly not the only one which a field so situated will receive from superior fences on every side. In upland pasture also, how often do naturally nutritious plants assume a stunted form, or die outright through want of shelter?, If a piece of the barest pasture field is covered with a little brushwood in growing weather, a tender herbage speedily appears, apparently different from all surrounding it. When grazed upon badly sheltered land, however good the soil may be, it is only the lighter and hardier animals that become fat; and even they, in cold seasons, are very imperfectly fattened. So much of the carbon of the food is required in such cases to maintain animal heat, that half the day is spent in gathering herbage for this purpose. In exposed districts, cattle are also more liable to diseases, such as catarrh, irrita-

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tion, congestion, and inflammation, than under better circumstances."

Such is the evidence that this gentleman, of extensive practical experience and accurate observation, gives in favour of the influence of Arboriculture; and our own, although considerably more limited experience, goes to substantiate the same thing. On an estate in the county of R——, the most of the land was high lying, and, consequently, very much exposed to cold cutting winds. The system of farming carried on was chiefly on dairy principles. The farmers were so much impressed with the benefits arising from Arboriculture, that they each gave off ground to the extent of several acres from their farms, to be planted for shelter, and continued to pay rent for the ground so occupied by trees for more than one lease! Numbers of them also enclosed several portions of land in the corners and exposed parts of their fields, in which they planted trees at their own expense. These plantations subsequently became valuable shelter to the adjoining fields, and under their influence the cattle were enabled to remain unhoused, and gather their food in cold rainy days without any risk of injury. Previous to these belts and sheltering clumps being available, the cows had not only to be kept and fed in the house during cold stormy days, but even in ordinary weather, the greatest attention was necessary to prevent the cows from standing about, or to use the farmer's own words, which are more expressive, "hangin' aboot the dykesides and no' eatin'," —lest they should take a "*shivering*" from the cold, which generally results in a falling off in the animal, and consequently a reduction in its produce. In fact, it not unfrequently happened that the animal died from the effects of cold rains. One of these farmers had to stock his farm twice with milk cows before the plantations formed on his farm had attained a sufficient height to afford any shelter to his adjoining fields. After the benefits of the plantations began to be felt, he never lost an animal from cold, he was besides enabled to keep a much finer and heavier breed of cattle; and there was an evident increase in the quantity of grass that grew in the district. On the same extent of land there were two, and in some cases three additional cows kept, while at the same time there was an increase in the produce of each cow; unquestionably proving that the grass had become more succulent and nutritious. Moreover, when under grain crops, there was also an obvious increase in the productiveness of the soil; the yield of both straw and grain being considerably greater per acre, and this was observed to be the case, more especially on those fields that were most under the influence of the plantations. Another good effect of the additional warmth was, that the crops became much earlier ripe, and were generally secured without suffering so much from inclement weather.

The result of all these improvements in the crop and stock of these farms, after the plantations had acquired a height sufficient to check and mitigate the wind, indubitably proves that when the climate is ameliorated by the influence of plantations, the soil becomes more fertile, and, in consequence, yields a richer return. Plants derive a great part of their nutriment from the air, and from the gases that are evaporated from the soil; and it is well known that a cold withering wind sweeping over a district, instead of accelerating the formation of dew, and increasing the latent heat of the earth, or promoting the evolution of gases, does the very opposite, by neutralizing the effect of the sun's heat, and lowering the temperature of the soil. But where a suitable shelter is provided, there is a greater degree of that genial warmth both in the air and the soil, which is so essential to all kinds of vegetation, as well as for the healthy development of animals. And it also proves that those diseases in animals which are known to result from exposure in a trying and changeable climate, can be thus averted. Another good effect of shelter on animals is, that it causes them to thrive better, and fatten much faster. This arises from the fact, that when animals are properly sheltered, there is less carbonaceous food required to keep up the necessary animal heat; but when unsheltered, a great part of the carbon in the food is consumed for the above purpose, and

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consequently there is a less quantity available for fattening.

In a report "On the General Principles of Reclaiming Land," Mr Thomas F. Jamieson, writing of shelter, says :—"If the position be bare or exposed, it will conduce much to the value of all subsequent operations that, before anything else is done, a good-sized plantation be formed on those sides from which the cold and stormy winds blow. It will add an inch or two to the height of every stalk of corn, and to the girth of every ox within the influence of its enfolding wings. Let the land for grass parks, and it will put a pound or two of more rent on every field which lies within the bosom of the wood. We have been able to keep the ploughs at work on the south side of a plantation about 100 acres broad, when on the other side they could not go for frost. The error will rarely lie in planting too largely: let there be at least 100 yards in breadth; but should there be a general absence of woods or shelter in the district, the extent should be greatly increased. The bleaker and more bare the locality, the broader and thicker should the plantation be. We have already shewn, from our own experience, as well as from the experience and observation of others, how very effectually the shelter produced by the influence of trees promotes the congeniality of the soil, and renders land more productive, even when it has been under cultivation for a considerable time. But the beneficial effects of shelter is perhaps more apparent on land that has been newly reclaimed from its natural condition. The soil of all newly-trenched land being left in a loose and open state,—and this, along with the effects of the draining off of the surface water, leaves the soil, even of a moderately sheltered field, more liable to suffer from drought. A newly reclaimed field, under the influence of a plantation, will yield a far heavier crop than one (even with a better soil) without shelter will do. The soil of the former is moistened by the plantations, and the wind mollified; and thus it is prevented from parching the soil. But the soil of the latter is not nearly so moist; and because it is deficient of shelter it is consequently more liable to become arid, both from the effects of scorching winds and the effects of the sun's heat. Experience and observation will prove this to be the case. In fact, we could give several examples of the superiority of the crops that are produced from a field that has been suitably sheltered a short time previous to being reclaimed. In some instances, we have known a field of the above description to yield a crop the double heavier than that which was grown on a field of better soil, treated in a similar way, but not benefited by shelter."

Dr T. Anderson, Professor of Chemistry, and Chemist to the Highland and Agricultural Society of Scotland, in an address delivered "On the Chemical Principles involved in the Reclamation of Waste Land," says :—"Belts of planting should be formed along the sides of reclaimed fields, particularly in the direction of the prevailing winds; and where the soil is of a non-retentive kind, rows should be planted along the line of all the fences. I am aware that this latter statement is at variance with agricultural practice in Scotland, where a determined warfare is waged against trees, on the plea that their roots exhaust the land of substances which would otherwise be absorbed by the crop, and that they serve to shade the soil. I do not doubt that this opinion is in many cases well founded, particularly where the trees are of the shallow-rooted species, which derive their nutriment from the surface soil; but deep-rooted trees, which penetrate into the subsoil, so far from exhausting, must rather improve the soil, because they absorb those matters which have descended into a stratum below that into which the cultivated crops send their roots. And these elements are accumulated chiefly in their leaves; and in the autumn, the greater portion of them is again deposited on the surface of the soil, with the exception of a very small quantity which is permanently retained by the wood. The deep-rooted trees, in fact, form one of those compensating means which nature so often employs, and are silently performing a work which never attracts our attention and

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are husbanding for us manurial matters which would otherwise be wasted."

Here, then, we have the evidence of this distinguished chemist, which proves that the influence of Arboriculture is an important auxiliary in the reclaiming, and improvement in every manner, of moor and waste land. For the shelter and genial warmth which the proximity of a mass of trees affords to newly reclaimed soil not only aids in the production of a better and more remunerative crop, but it is also a powerful agent in assisting to maintain the increased fertility of the soil, and in preventing it from returning to its original sterile condition, which it is very apt to do if left in an uncultivated state for a few years. This sometimes happens with unsheltered fields which are laid down in grass shortly after being reclaimed. If part of a moorland district, where the ground is for the most part covered with heather, is planted either by nature or art, after a number of years' growth it becomes apparent that the influence of a mass of trees is begun to be felt. The heather is gradually seen to get less luxuriant, and after the plantation has reached a good height it eventually gives place to a grassy herbage. This is found to be the case, not only below the trees, but also beyond the boundary of the plantation. On the leeside, as far as the warmth and shelter of the trees is effectually felt, the grass becomes more succulent, and the heather, like a tender exotic planted on a cold exposure, looks as if it felt a little out of place, and gradually disappears. In proof of this, we may mention an instance that came under our observation in the county of ———. The line of march between two estates went through a tract of moorland, each property having a portion of moor which was mostly covered by heather, with little or no difference in the quality of the soil or subsoil; there was, however, a difference in the exposure, the one portion being more elevated, and lying exposed to the north-east wind. The proprietor of this most exposed part had, some forty years ago, planted the most of his ground with a crop of larch, which, except at the northern extremity, and in some damp places, had grown very fast. Some years after planting, the heather began gradually to disappear under the trees; and after the plantation had been several times thinned, grass began to grow luxuriantly. When the trees on the lower portion of the ground were thought to be strong enough to resist the effects of cattle, part of the lowest lying ground was fenced off, and the trees thinned to a good distance apart. The proprietor then turned in a lot of cattle to graze; and this was continued for a number of years, and the situation yielded fine pasture, the trees being gradually thinned out; and it is now under a regular rotation of cropping, having been trenched after being pastured for a number of years. And although at a higher elevation, and with a soil hardly so deep as those fields that had been previously reclaimed, it continues to grow as good crops.

The upper part of the plantation is now well thinned out and affords excellent shelter and good pasture for a number of cattle. The pasture itself is known to be worth more than double the value per acre of the heather on the adjoining estate. All this shews very clearly the great value of Arboriculture; for, independently altogether of the value of the crop of wood which grew on the land, this experiment, by thus causing the heather to disappear and a good crop of grass to take its place, has proved amply remunerative. The chemical and the mechanical action of the roots in the soil, combined with the shelter and the annual fall of foliage and decayed branches, assisted in fertilizing the soil and in making it more suitable for cereal crops. The cultivated value of the soil was from 30s. to 40s. per acre, and on the more elevated parts, where some of the crop of wood was left, its value as pasture was 10s. per acre. In order to ascertain the former value of the land, and the immense benefits of Arboriculture as a fertilizer of the soil, look at the state of the unplanted moorland on the other property. The proprietor trenched the lower part of it, and put it under a rotation of cropping, and the highest rent ever obtained for it was 10s. per acre. And this the tenants (unless from fields which were

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influenced by the other proprietors' plantations) could hardly pay! The more exposed portions were left in their natural state as rough pasture, and brought less than 3s. per acre! Now exclusive of all the additional increase to the value of the land, the proprietor who planted and thus took advantage of the influence of Arboriculture to assist him in the development of the resources of the soil, received a fair rent for the crop of wood. When cut, the greater part of the larch trees were peeled, and the bark brought from £3, 10s. to £4, 7s. 6d. per ton. The timber was generally sold for pitwood purposes, and brought 6s. per 100 feet for ordinary size, while the heavier kinds brought from 10s. to 14s. per 100 feet lying cut in the wood. Sometimes it was sold at 7s. per 100 feet, and any root cut that was thought suitable for a railway sleeper was sold at 1s. per cubic foot, the top of the tree being treated as pitwood.

In order still further to illustrate how very effectually a crop of timber improves the soil, we may mention another instance, where upwards of 60 acres of moorland soil, portions of which (principally the most exposed parts) had been planted. The whole extent was trenched and treated alike, and those parts which had been under wood, produced a crop, according to the farmer's own words, "one half better than the other land;" and it still continues, after several years of successive cropping, to yield a much finer crop. This increased fertility of the soil is doubtless occasioned by the roots of the tree gradually penetrating into the subsoil for nourishment, and by this means the soil is stirred, and consequently absorbs more moisture from the atmosphere, which, in conjunction with the annual accumulations of vegetable matter, increases the crop bearing capabilities of the soil.

The entire removal of the shelter and warmth that is provided by a crop of trees has a deteriorating effect on both soil and stock. Many examples of this might be given, but let one suffice. Nearly 100 acres of woodland were trenched out, and though it was in an exposed situation there were no trees left for shelter, the land being afterwards cultivated for a year or two, and then laid down in pasture; and before it was twenty years cleared it had almost returned to its pristine sterility. Immediately after the destruction of this plantation the adjoining fields also became less productive.

In conclusion, let us state that our object in writing this paper has been to follow up (though we have done it but very imperfectly) Mr Wm. Brown's very able paper on "Trees and Climate," and by contributing our humble mite of information to endeavour to direct attention to this most fertile field for research, and, if possible, to incite some of our young assistant foresters to devote more of their energy and spare time to aid in the further elucidation of the uses and the effects of trees. A more elaborate and accurate investigation into the effects of trees on the soil and climate of this country is much needed at the present time; and the immense importance of such an inquiry ought surely to induce many of our most able and experienced members to come forward and state the results of their observations, which would unquestionably aid materially in accelerating the scientific and practical advancement of Arboricultural knowledge. Doubtless, there is a great extent of the waste land in this country that might be profitably reclaimed and added to our cultivated soils; and even those portions that are utterly unfit for ever becoming cultivated land might be improved to a considerable extent, if advantage were taken of the beneficial effects and kindly influence of Arboriculture. By thus developing the resources of the soil, and making it available for the production of additional food to supply the wants of our daily increasing population, the welfare and prosperity of the country is promoted.

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XX.—*ON THE ECONOMIC USES AND COMPARATIVE VALUE OF DIFFERENT DESCRIPTIONS OF TIMBER GROWN IN SCOTLAND.*

BY ROBERT HUTCHISON, ESQ., OF CARLOWRIE.

SITUATED as Scotland is in regard to insular position, with an unequal and variable climate, possessing singular diversities of soil, and capabilities of producing over a large area of her surface cereal and root crops of the finest description—the object of the occupation of any portion of the country with timber trees must be threefold. Plantations are formed either for shelter, ornament, or profit. It is with timber planted under the last aspect that we propose in the present paper to deal; for the value which woodlands, after a given number of years' growth, will yield, may be stated to be pretty much in proportion to the utility of the object with which it was originally planted, and to the judicious selection of species suited to that purpose, in relation to the chosen soil, situation, and exposure.

Leaving out of view, therefore, for the present, the consideration of the ultimate value of wood in a commercial point of view, when planted either for shelter or ornament, and assuming that the object which the planter had in view in such instances is attained shortly after he has planted his trees, and that their comparative value as timber is beyond the sphere of our present inquiry. Although land so planted may be still profitably occupied, we proceed to consider the economic uses to which timber trees generally planted in Scotland, *as a crop*, are usually applied.

The species of trees in use in this country for general profitable planting purposes are of course either hardwood (deciduous), or pine (coniferous). These are generally placed in mixed plantations, *i. e.*, the hardwood trees are at first sparsely planted, and the interstices filled up with firs and pines, as nurses, which are destined to be cut out from time to time, as the wood requires to be thinned, so as to admit light and air to the hardwood trees, which are planted with the purpose of becoming heavy timber. Sometimes, however, plantations are formed in large tracts of pinewood only, and this mode of planting is not unprofitable, or the least remunerative, where the situation is favourable. If the mixed mode of planting be adopted, the hardwood timber trees usually planted in Scotland are oak, ash, elm, beech, poplar, willow, alder, plane, birch, lime, and chestnut. The latter two varieties, however, are, *as wood*, comparatively of little value, and are chiefly used to add to the effect and variety of foliage, or for purely ornamental purposes. If pinewood alone is planted, Scots fir, American and Norwegian spruce, silver fir, and larch, are the staple varieties employed.

The economic uses to which these two classes of timber are applied are as distinct as the families to which they respectively belong.

In former years, before the net-work of railway communication had been so far spread over Scotland as it is at the present day, the value of fir and larch was considerably higher than that of hardwood; for while the use of native firwood was universal in architectural appliances, it was also indispensable for local mechanical purposes, as well as of some value not only for home use—such as enclosures, gates, &c.—but also for similar purposes beyond the mere local demand of the district. As regards hardwood, the extension of railways, and consequent development of the products of the country, has materially increased its value, both by affording the means of speedy and cheap transit to distant markets where such descriptions of timber had long been in demand, and by creating an entirely new branch of wood consumption. Twenty years ago—in many districts in Scotland now

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opened up by railways—when the only means of transit for wood was by haulage in carts over roads, which, in these remote timber-supplying localities, were hilly and rough, and in the winter season and spring, when the autumnal felling chiefly wanted an outlet, were almost if not altogether impassable, the value of hardwood timber grown at a distance from any large town, or centre of manufacturing enterprize, was scarcely more than nominal; for the chief use to which it was applied was for fuel; but now that the facilities of railway conveyance have made distance and situation of comparatively little consequence, large quantities of timber of all sorts, but chiefly hardwood of particular kinds, are conveyed from all parts of Scotland to Leeds, Manchester, Nottingham, Halifax, Liverpool, London, and other great centres of manufacturing and commercial industry in England.

Of all the various varieties of hardwood trees usually grown in Scotland, the *oak* is probably the most valuable, as a crop, from the variety and importance of the many purposes to which it may be applied, although the extreme slowness of its growth renders profit from growing oak wood a matter of remote calculation. The great, and at one time—about a quarter of a century ago—the really distinctive use to which home-grown oak was applied, was for ship-building; its flexibility, hardness, toughness, and durability, rendered it invaluable for this purpose; and its capability, when once submerged, of resisting the action of water longer than almost any other wood, further tended to render it the chief wood for naval architecture. Crooked or "*knee pieces*," as well as straight logs, came alike welcome to the ship-builder's yard; and it was no poetic license or metaphor merely, when to the "Hearts of Oak," and "Wooden Walls of England," were ascribed the foremost rank in the history of naval architecture of the civilized world, as they had already for themselves achieved that post of honour among the navies of the globe. But the progress of scientific discovery, ever keeping pace with the rapid strides of British commercial enterprize, sought out the means and material most calculated to increase the speed of the merchant navy, and so by the rapid transport from port to port of rich cargoes, to distance time, and take advantage of fluctuating markets; and thus lighter woods for the build of the racing-clippers came into use—larch, mahogany, and teak, displaced the oak;—and finally, iron—that powerful giant of progress on land—was launched with all the prestige of former victories ashore, to add fresh laurels to British skill afloat, and to displace, to a great extent, the old renown of England's oak as the staple material of her dock-yards. In household architecture also, oak was formerly of great value, and it is still extensively employed in the fittings and finishings of first-class buildings, as well as in making furniture. To these purposes the larger and heavier kinds of oak wood are adapted; while the smaller cuts are used in cooper-work for staves, and also in the manufacture of spokes for vehicle wheels; the smaller branches lopped off from the fellings are of considerable use in chemical works for the extract of pyroligneous acid, &c.; and the bark is of increasing value for tanning purposes: so that every portion of the tree is of some commercial value, and there is less waste or refuse in oak than in any other timber grown for profit.

The ash stands next to the oak in point of general commercial utility and importance. It has this advantage, indeed, over the oak, that it is a much more rapid grower. Its timber possesses the two great qualifications of toughness and elasticity. It is much employed for all country purposes, and by mill and wheel wrights; it is also used when cut from young straight trees of about twenty to thirty feet in height, for oars, for which its toughness and elasticity renders it peculiarly well adapted. The cooper and tanner both employ it largely; and on sea-coast towns and fishing stations, its small wood is eagerly purchased, in the proper season, for drying and curing herrings. Fishermen also employ its bark for tanning nets; so that in every respect, the ash is a very profitable tree to grow, and may be turned to account at any stage of its growth, from that of the mere twig or switch, up to the largest and heaviest timber. Next in

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point of important economic use, may be placed the elm, as a valuable timber tree. It is very extensively used by coach-builders, and in the large manufactories of locomotive plant which the expansion of the railway system has called into existence in many parts of the country. It is also largely employed in ship-building; and by engineers of water-works.

Although the wood of the beech is generally esteemed soft, and therefore badly adapted for many purposes, this tree has, nevertheless, considerable commercial importance. Its chief use, when it can be procured of large dimensions, is for making printing blocks, bobbins, and rollers for the large manufacturing mills in Lancashire; also for the handles of edge-tools; and it is in great request, since the scarcity of procuring boxwood arose, for the purposes of the turner, and wood-carver; and large quantities are annually consumed by the chairmaker in many localities of England. The small wood and branch timber are extensively used in the production of wood-vinegar and charcoal.

Another of our common Scotch hardwood trees, which is deserving of more extended introduction, is the poplar. Indeed, since the progress of the larch disease in Scotland has led to a failure in the supply of that much and justly esteemed wood, the value of poplar as a substitute has been more fully recognized by many planters; and it is now held in more estimation, and has risen in value of late years. In some quarters it is used for railway sleepers, and if it shall prove of sufficient merit, after a fair trial, to become generally useful for such a purpose, there can be no doubt of the necessity for a more extensive introduction of this tree into every suitable soil and situation.

The failure in the supply of larch sleepers has led to the introduction upon our railways, in almost every locality—where the replacement of old larch sleepers was necessary—of foreign timber, principally Baltic whitewood, and which, in addition to the necessity for adventitious chemical appliances to render it more durable as a sleeper, and to throw off the action of the changes from wet to dry weather, is dearer in its first cost than the old larch sleeper. If, therefore, a home grown wood like the poplar, which has the advantage also of quick growth, can be introduced, there can be no doubt that much benefit will arise, and result to the enterprize of our home wood growers.

Poplar wood of sufficient scantling is also now much used in the manufacture of gate-posts; and from its non-inflammable nature, and fine white colour when dressed, it is well adapted for flooring-deals; and used for this purpose it will be found less liable to split than fir wood, and less apt to warp if exposed to the sun than larch.

We might thus specify a distinctive use for each of our home hardwood trees, and shew that they have each a commercial and profitable value, as well as that they are worth cultivating for their mere beauty, or for landscape effect; but we shall content ourselves with only further noticing the willow, and glance cursorily at a few minor trees.

In damp soils, no crop will be found so remunerative as willows; and certainly none, in our opinion, so picturesque. There is probably no timber, or rather tree, which is capable of being profitably employed in such a diversity of uses. From the twig of a year's growth to the furrowed trunk and twisted giant limbs of the centenarian—a use is found for this tree. The wood of the old tree is tough, strong, and exceedingly useful for country jobbing purposes. It is invaluable for "cleading" and lining carts, quarry-waggons, and trucks, and mining hutches, for steamboat paddles, and for the buckets of mill wheels, and other parts of machinery connected with water-power. One use to which it is applied almost exclusively is in the manufacture of the break-blocks for all railway waggons and plant generally. Grown as a crop in a few districts, for wands, the willow is a very valuable plant. It has been calculated that the annual average yield per acre under such circumstances, and under good management, will be at least £12, after allowing for expenses and cutting; and some authorities state that they have realized as high as £18 per acre per annum!

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The opening up of many new coal fields and other mineral pits, of recent years, has created a market for wood of all descriptions, of smaller dimensions, to be used as pit-props; so that within the last twenty years, much of what had been previously used only as fuel, is now profitably employed for such purposes. In this respect the wood of the alder is much esteemed; and besides being useful for the purposes of the turner, this tree is of considerable value in the manufacture of charcoal for gunpowder in the government arsenals; and there are many other of the smaller trees of different descriptions which are now capable of being economically used, and to advantage, since markets have been rendered more attainable, and the discoveries of chemical science have turned attention to the utilization with profitable result, of what some years ago was deemed valueless prunings, or useless brush-wood.

The economic uses to which fir wood grown in Scotland is commonly applied, may be stated generally as out-door rural work; or in erecting farm sheds and steadings, for country cartwright work, fencing, and general estate repairs. Its use in architecture is now superseded almost entirely by the introduction of large quantities of foreign timber, both in the form of battens from the Baltic, and in logs of yellow pine and other American timber which successfully compete with our native fir for all such purposes; and the introduction of this Canadian and Baltic timber has materially kept in check the price of British fir or coniferous timber. Notwithstanding this, however, the increase in the value of our home grown wood, of both hard-wood and coniferous descriptions, has been very considerable on the average over the country generally within the past twenty years. We have been informed that in Aberdeenshire, the price of timber home-grown is about one-fourth higher than it used formerly to be before the opening up of railway communication. This important rise in the value of plantations is doubtless owing, in many localities in the northern districts of Scotland, to the introduction of railway systems into these places, and also to the smaller area of ground under timber crop, owing to the improved methods of farming now happily prevalent, rendering the growth of cereals and root crops no unusual or uncertain matter in soils and situations which some few years ago were occupied as woodlands. The enhanced value of larch and fir wood has, on the average during the last twenty years, in Scotland, been even greater than that of hard wood. In some districts, the price of these descriptions of wood has doubled in that time. This remark, however, applies only to the northern localities; for in the lowlands, and in the neighbourhood of large towns, the price has rather fallen off than increased, owing to railway communication having brought timber from other parts of the country to compete with that grown near the localities where it is in demand; so that at the present day, the price of wood of home-growth is pretty much equalized over the whole country.

To plant a profitable crop of timber with the quickest return, the varieties of the trees to be used must vary with the differences of soil, altitude, and climate. We may, however, condense our recommendation in the following manner:—

1st, For high exposed altitudes, and upon poor soil, plantations of beech only (Fagus sylvatica) will generally, under suitable management, be found most quickly remunerative, as well as admirably adapted (if allowed to remain), as a valuable assistance in such situations in ameliorating the climate of the adjacent pasture lands or fields.

2d, On high exposed moorlands, Scots fir alone, or after a few years growth, an addition of larch, and spruce, and silver fir, to Scots fir plantations, will be found suitable and remunerative, and will return a better rent than mere pasture in such a situation.

3d, Upon clay land, or deep loam, with clay or gravel subsoil, plantations of oak (Quercus robur), with a mixture of larch, or Pinus Laricio, or both, will be found to be most rapidly remunerative, and will pay well if the subsoil be not *too* retentive of moisture.

4th, In good deep soil of alluvial nature, a fair mixture of the various hardwoods we

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have named in the foregoing paper, and either with or without the addition of a few spruces, Scots fir, and larch, will generally prove satisfactory; or if it is preferred in such situations and in lowland country, a mixture of elms (Ulmus sativa), and ash (Fraxinus excelsior), with the same pines, will be found very remunerative in a short time.

5th, In wet soil, in a fen country, or near damp hollows, the most rapidly productive tree to plant is the willow (Salix caprea), or a mixture of willows, alders (Betula alnus), poplar (P. canescens, or P. monilifera).

6th, For a second crop of timber from the same ground after the realization of a former crop, the most suitable tree to plant is the Scots fir, and land so occupied will again yield a very fair return within a very few years from the date of the felling of the original crop.

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XXI.—*ON THE ECONOMIC USES AND COMPARATIVE VALUE OF DIFFERENT DESCRIPTIONS OF TIMBER GROWN IN SCOTLAND.*

BY CHRISTOPHER YOUNG MICHIE, FORESTER, CULLEN HOUSE.

WE have observed that the longer the period is between that of sowing and reaping, or planting and cutting down a crop, so in proportion are the risks of failure and loss. For example, our ancestors planted beech very abundantly, on account of its extensive use in their time for machinery, and for such purposes it realized high prices. Planters, therefore, such as the Earl of Findlayter, Lord Blantyre, Lord Kinnoul, the Duke of Hamilton, and many others, who calculated upon the same prices being realized a hundred years hence, lost by such an investment. The Duke of Athole also, who planted larch extensively, on account of realizing, as he did, at the time from 2s. to 3s. per cubic foot might have found a narrow margin had he lived to see it sold at half that price. On the other hand, those who planted sycamore at the same period, when the wood was scarcely sought after, and only to a limited extent for turnery purposes and fuel, would now be happily surprised to find a better demand and different application of it in connexion with the manufacture of cloth and similar goods, for which purposes double or triple the prices realized fifty years ago are now obtained. Those planters also, who, either for the sake of variety of trees upon their estates, or the pleasure of seeing them grow up quickly only to be cut down for subordinate purposes, without regard to profit, would now be happily surprised to find that alder, poplar, willow, lime, and other similar descriptions of wood, which at the time of planting were all but unsaleable at any price, are now eagerly sought after, and for which, highly remunerative prices are given. It may, therefore, safely be assumed, that as trade and commerce have undergone changes and fluctuations in the past, so will they also in the future; hence the difficulty of predicting what the state of affairs will be as affects the price of wood fifty or a hundred years hence. That which now demands the highest price may, for aught that we can tell, realize the lowest after, and *vice versa*. Arboriculture, thus differing so vastly from agriculture or horticulture, causes it to be dealt with in a way and manner essentially different from either. Probably the best and wisest mode of procedure is to act upon the maxim, "present duties belong to man, and issues to God." It is therefore best to exercise to the utmost the faculties of reason and discernment, and act in regard to Arboriculture as in other matters, by doing that which at present seemeth right, leaving the future to provide for itself. In the matter of growing trees we have, fortunately, many guides and instructors, and in no school could we better learn, or receive instruction, than from the growing trees in the surrounding woodlands.

We shall endeavour as briefly as the subject will admit of, to explain the circumstances under which several woods and plantations have succeeded and done well, and several others have not.

I. Is a Scotch pine plantation, 90 years planted, comprising about 100 acres, with a hundred trees per acre, each tree containing about 30 cubic feet of timber = 3000 feet at 10d. per foot = £125. This sum divided by 90 (the number of years old) gives £1, 7s. 9¼d. as the yearly return per acre, while similar ground to that occupied by the plantation is worth 10s. per acre for grazing purposes. Allowing, for the sake of brevity, the thinnings and shelter afforded to the surrounding fields to stand as a set off against compound interest upon the sum originally invested, in planting, the results would stand thus—

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Value of crop of wood . . .	£125	0 0
Expense of plants and planting	£4 10 0	
Rent of ground for grazing purposes .	45 0 0	
	49	10 0
Balance in favour of planting	£75	10 0

II. Is another Scots pine plantation, 50 years old, comprising 1600 acres, containing on an average 500 trees per acre, and valued at 1s. 6d. per tree = £37, 10s. The ground for grazing purposes, being of the poorest description, was worth only 2s. 6d. per acre. The comparative value of the ground for grazing and planting, abating as in the former case compound interest upon original outlay, stands thus:—

Crop, 500 trees, at 1s. 6d. each .	£37	10 0
Rent of ground . £6 5 0		
Cost of plants and planting 4 0 0		
	10	5 0
Balance in favour of planting	£27	5 0

The produce of this plantation was chiefly manufactured into staves, for the Newcastle market, or sold as pit-props in Paisley or Glasgow.

III. A Scots pine plantation, comprising about 200 acres, and seventy-five years old. The trees—

168 trees, averaging 15 feet each = 1520 feet, were sold at 7½d. per foot =	£47	10 0
100 spar-wood trees, 5 to 8 in. diameter, at 12 ft. at 1s. each =	5	0 0
80 prop-wood trees, 3 to 5 in. diameter, at 12 ft., at 4d. each =	1	6 8
Total value per acre	£53	16 8

Value of planting as compared with grazing, abating compound interest upon original outlay, as above—

Value of crop of wood . . .	£53	16 8
Cost of plants and planting per acre . . £3 10 0		
Rent of ground, 75 years, at 2s. 6d. per acre . 9 7 6		
	12	17 6
Profit in favour of planting .	£40	19 2

The produce of this plantation was manufactured and used as follows:—The largest and best of the wood for roofing, flooring, and other building purposes; the coarse and more inferior class for railway sleepers; a smaller class was sawn into sleepers for mining purposes, staves, and heading; and the smallest description for pit-props.

IV. Is a growing Scots pine plantation, forty years planted, and containing 40 acres, with an average of 300 trees per acre, each on an average is worth 2s. = £30. The ground, for grazing purposes, is worth 10s. per acre; and assuming that the plantation would not increase in value more than the present worth of the ground for grazing, the present balance would stand nearly thus:—

Enclosing plants and planting per acre	£6	0 0
Rent of ground for 40 years at 10s.	20	0 0
Total amount of outlay . .	£26	0 0
Value of crop, as standing upon the ground	30	0 0
Balance in favour of plantation	£4	0 0

V. Is a larch plantation, comprising about 10 acres, which was duly thinned to thirty-two years' growth, when it contained 120 trees per acre, each tree averaging 25 cubic feet. The ground previous to planting having been under cultivation, induced the trees to make very rapid progress in growth; but at the above age they had already begun to indicate signs of decay, which occasioned their being cut down. The ground, which was a sandy clay, was by no means valuable for agricultural purposes, being estimated only at 15s. per acre.

The comparative results between agriculture and planting, in this case, stands thus:—

120 trees at 25s. each . . =	£150	0 0
Original expense of plants, planting, &c. .	£3	0 0
Thirty years' rent at 15s. per acre =	22	10 0
	25	10 0
Balance in favour of planting	£124	10 0

It is here worthy of remark that this is

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one of those exceptional cases where ground pays better under planting than under agriculture, and it is well to study the nature and capabilities of the soil for producing any particular description of crop of trees before planting. The agriculturist and horticulturist set before the arboriculturist many examples worthy of imitation in this respect.

VI. Is a series of larch plantations, comprising about 150 acres, and fifty years old. The trees, on an average, stand from 14 to 17 feet apart = 150 to 200 trees per acre, and contain from 5 to 50 feet of timber each. In this, as in most other plantations of considerable extent, there are portions not worth one-fourth of the sum stated in V., as above; hence the difficulty and uncertainty of ascertaining, without valuing the whole plantation, tree by tree, the proportion of good and inferior crop.

An important circumstance, and worthy of notice, in connexion with these plantations is that of the value per acre, being just the inverse of the number of trees upon it. Where the number of trees is fewest, the value is greatest, and *vice versa*.

The respective valuations of the plantations are as follows:—200 trees at 8s. each = £80 per acre; 170 trees at 10s. each = £85 per acre; 150 trees at 11s. 6d. each = £86, 5s. per acre. Taking the average at 170 trees per acre, containing 10 feet each = 1700 feet, at 1s. per cubic foot = £85, and the original cost for enclosing plants and planting—about £6 per acre. The value of the ground for grazing purposes is from 3s. to 5s. per acre, and shews the comparative advantages between planting and grazing.

Average value of crop (at fifty years old) per acre	£85	0 0
Cost of plants, planting, enclosing, &c.	£6 0 0	
Rent for fifty years, at 5s. per acre .	12 10 0	
	£18 10 0	
Balance in favour of planting	£66	10 0

Having cited several examples illustrative of the comparative profitableness of planting, resulting, as has been shewn, or may be inferred, from the trees being well adapted to the soil, without which a planting must fail, or prove a loss, we shall next quote a few examples of failure of growth, without adverting to losses sustained by other means, such as sales, manufacturing, and such like.

VII. Is a mixed plantation of about 12 acres, and forty years old, composed of at least eight sorts of trees promiscuously mixed. The tendency of the plantation has uniformly been for the trees to prolong their upward growth at the sacrifice of their girth; and the treatment necessary to maintain the balance between height and girth has been such as to cause too many trees to be thinned out before they were of any appreciable value, and leave the crop too thin upon the ground to be afterwards profitable.

The present market value is a little below £20 per acre, whereas upon such ground it should have been at least worth £30 per acre.

The following statement will shew the comparative failure or unprofitableness of the plantation, viz., 144 trees at 2s. 10d each, per acre . . . . . = £20 8 0

Rent of ground, at 15s. per acre, for forty years	£30 0 0	
Original cost of plants, planting, enclosing, &c.	7 0 0	
		37 0 0
Balance in favour of grazing	£16	12 0

It is necessary to state, in connexion with this plantation, that, being destined ultimately to form a hardwood one, which is longer of becoming profitable than pine or fir plantations are, the time for shewing its profit or loss has not yet fully arrived.

VIII. Is a mixed pine and fir plantation, fifty years planted, comprising about 40 acres. Four thousand trees per acre were originally planted, and the exposure being considerable, the trees were allowed to grow up, with a view to shelter each other, till they were between 20 and 30 feet high, with stems scarcely 4 inches diameter at base. The least exposed parts were thinned before much injury was sustained by the trees; but the exposed parts were not thinned till the vitality of the side branches was destroyed to fully two-thirds of the height of the trees.

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The ultimate effects of the protracted thinning has proved so far injurious as to render the value of the plantation only nominal. In proof of this, other plantations of similar age, but thinned in due time, were yielding trees sufficient to make railway sleepers, while this one was only producing prop-wood; or while the properly thinned plantations were yielding trees worth from 5s. to 7s. 6d. each, this was yielding them worth only so many pence.

The average number of trees per acre is 450, and are worth, according to market price, 6d. per tree upon an average = per acre £11 5 0

Rent of ground for fifty years, at 5s. per acre . £12 10 0

Expense of plants, planting, enclosing, &c. 3 10 0

16 0 0

Balance in favour of grazing £4 15 0

In this case, the true and only cause of failure was in consequence of want of timeous thinning.

Would space permit, we might cite other examples to shew how mixed plantations are less remunerative than those composed of one sort of trees only, or at least in groups, if otherwise adapted to the soil, each class by itself; but as such a statement, in order to make itself sufficiently clear and comprehensive, would necessarily be a long one, we must defer it to another opportunity.

IX. Is an oak plantation, or rather the last remnant of what constituted one of the natural forests of the country, and is preserved by its proprietor as a relic of the past. It comprises altogether only about two acres. The trees, as they stand, shew unmistakeable signs of being stock-shots. Some old records are preserved recording an extensive fall of oak, either at or contiguous to the place where those are found growing. The records state that the fall of oak took place about 200 years ago, and it is quite probable that the surmises respecting it are correct. Having examined this grove of oak with considerable care and minuteness, we conclude respecting it as follows:—To state the number of trees would lead to misapprehension, as they have not risen into single trees, but divide into several members, either at, or a short distance above ground; hence the difficulty of determining whether each group should be described as one tree or several. We may however state, that, except in respect of height, we do not conceive how a heavier crop of timber could grow upon the ground, the trunks being literally touching each other.

The probable quantity of timber upon an acre is 5000 feet, which, at 2s. per cubic foot, represents £500; and, as the probable growth is 200 years, the yield annually would be 50s. per acre.

The ground, for agricultural purposes, is worth about 30s. per acre, and the estimated cost of planting would be about £6 per acre.

A crop of oak would attain the highest value per acre of any description of wood, because it remains sound and continues growing probably twice as long as most other trees; but, at the same time, larch, and indeed most other trees, pay the proprietor better than oak, because, of them, several crops can be grown while only one of oak is produced.

XI. Is a plantation of black Italian poplar, comprising about one acre. Age of trees, forty years; distance apart, 15 feet = 193 trees per acre; containing on an average 30 cubic feet = 5790 feet, which, at 8d. per foot, is = £193; the latter sum, divided by 40, gives £4, 16s. 6d. as the annual return per acre.

Comparative profitableness and advantages of planting poplar over that of grazing the ground:—

Value of crop £193 0 0

Rent for forty years, at 25s. per acre . . . £50 0 0

Expense of plants, planting, enclosing, &c. . . 8 0 0

58 0 0

Balance in favour of planting, minus compound interest on outlay £135 0 0

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The prices of wood varied much more at one time than they do now; and as free trade develops and commerce increases, together with increased facilities of transport, so will the price of wood continue to equalize itself throughout the country. The annexed are the prices realized for the best descriptions of wood at the following places at the present time :—

Newcastle market, 3s. per 72 lineal feet (or what is termed a dozen props), implying that there are either twelve of them 6 feet in length, or a greater number in shorter lengths.

Crown-props, which should stand 5 inches in diameter when dressed, that is, after a chip is taken off each of the four sides, realize in the same market, 5s. 3d. per dozen (72 lineal feet).

Species of Tree.	Aberdeen.	Edinburgh.	Glasgow.	Dumfries.	Inverness.	Perth.
	s. d. to *s. d.*	*s. d.* to *s. d.*	*s. d.* to *s. d.*	*s. d.* to *s. d.*	*s. d.* to *s. d.*	*s. d.* to *s. d.*
Ash	1 6 to 2 6	1 6 to 0 8	1 0 to 1 8	1 3 to 1 8	1 10 to 2 0	1 3 to 2 6
Alder	0 10 ,, 1 3	0 9 ,, 1 0	0 8 ,, 0 9	0 8 ,, 0 10	0 6 ,, 0 7	0 9 ,, 1 3
Beech	0 10 ,, 1 0	0 8 ,, 1 0	0 8 ,, 0 10	0 7 ,, 0 9	0 7 ,, 0 10	0 10 ,, 1 0
Birch	0 8 ,, 0 10	0 9 ,, 1 0	0 8 ,, 0 9	0 8 ,, 0 10	0 6 ,, 1 0	0 9 ,, 1 3
Elm	1 6 ,, 2 6	1 3 ,, 1 8	1 0 ,, 1 8	1 4 ,, 1 6	1 9 ,, 2 0	1 6 ,, 2 0
Horse Chestnut	0 9 ,, 0 10	0 8 ,, 0 9	0 8 ,, 0 9	0 6 ,, 0 7	0 8 ,, 0 10	0 8 ,, 0 9
Hornbeam	1 0 ,, 3 0	1 0 ,, 3 0	0 10 ,, 1 6	1 4 ,, 1 6	1 9 ,, 2 0	1 6 ,, 2 0
Evergreen Oak	1 6 ,, 6 0	2 0 ,, 5 0	3 0 ,, 6 0	1 0 ,, 4 0	2 6 ,, 5 0	2 0 ,, 4 0
Larch	1 3 ,, 1 8	1 4 ,, 1 8	1 2 ,, 1 4	1 0 ,, 1 2	1 0 ,, 1 2	1 0 ,, 1 6
Lime	0 10 ,, 1 6	0 10 ,, 1 3	0 9 ,, 1 3	0 8 ,, 0 10	0 6 ,, 1 3	0 10 ,, 1 3
Laburnum	1 0 ,, 2 0	1 6 ,, 2 6	1 6 ,, 2 3	1 0 ,, 2 0	1 0 ,, 1 6	1 0 ,, 2 6
Oak	1 6 ,, 2 3	1 8 ,, 2 0	1 4 ,, 1 8	1 6 ,, 2 3	1 8 ,, 2 0	1 8 ,, 2 3
Poplar	0 10 ,, 1 3	0 10 ,, 1 3	0 8 ,, 1 0	0 8 ,, 0 10	0 6 ,, 1 3	0 9 ,, 1 3
Scots Pine	0 8 ,, 1 0	0 9 ,, 1 0	0 8 ,, 0 10	0 9 ,, 0 10	0 6 ,, 0 7	0 8 ,, 0 10
Spruce	0 8 ,, 0 10	0 9 ,, 1 0	0 8 ,, 0 10	0 9 ,, 0 10	0 6 ,, 0 7	0 8 ,, 0 10
Sycamore	1 0 ,, 3 6	2 0 ,, 3 6	1 6 ,, 3 6	1 0 ,, 2 0	1 6 ,, 3 0	1 6 ,, 3 6
Sweet Chestnut	1 0 ,, 2 0	1 0 ,, 2 6	1 6 ,, 1 10	1 0 ,, 1 6	1 2 ,, 1 8	1 6 ,, 2 0
Willow	0 10 ,, 1 3	0 10 ,, 1 0	0 8 ,, 1 0	0 8 ,, 0 10	0 7 ,, 1 3	0 9 ,, 1 3

Wood, of any description, is sold occasionally at prices considerably higher than those above quoted; because at times extra good or suitable pieces are required for certain special purposes, for which higher prices are given; but it will be found that the prices above quoted are very near the truth, and wood can either be bought or sold at them to almost any extent. The proprietor, however, must calculate upon deriving for his wood produce a sum less than that above quoted, equal to that which is required to convey it to the market.

In addition to the foregoing list of prices, there are others necessary to be known, in order to determine the produce of woods—such, for example, as pit-props, spar-wood, and wood occasionally sold by the ton.

As Newcastle, Glasgow, and Paisley, are amongst the principal markets for these, we annex the present current prices.

Common Scots pine pit-props delivered in Newcastle market, 3s. per 72 lineal feet (or what is termed a dozen props), implying that there are either twelve of them 6 feet in length, or a greater number in shorter lengths.

Crown-props, which should stand 5 inches in diameter when dressed, that is, after a chip is taken off each of the four sides, realize in the same market, 5s. 3d. per dozen (72 lineal feet).

Spar-wood, which comprises trees between pit-props and timber size, from 6 to 8 inches diameter at 12 feet from the ground, realizes in Newcastle market, 10s. 6d. per 100 lineal feet.

Spruce and silver fir are sold at the same prices as Scots pine, but larch is from 1s. 4d. to 1s. 5d. dearer.

					Each.
Scots pine sleepers,	9 feet long	10 × 5,	realizes		2s. 6d.
Spruce	do.	do.	do.	do.	2s. 6d.
Silver fir	do.	do.	do.	do.	2s. 6d.
Larch	do.	do.	do.	do.	3s. 3d.

Small scantlings for mining purposes, of Scots pine, spruce, or silver fir, 5 inches by 2, are sold at from 11s. to 12s. per 100 lineal feet.

Larch of the same dimensions, and used for a similar purpose, realizes from 14s. to 15s. per 100 lineal feet.

Scots pine, spruce, and silver fir, ¼-inch staves, realize from 34s. to 36s. per 1000 superficial feet.

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Larch staves of the same thickness, realize from 68s. to 74s. per 1000 superficial feet.

Scots pine 1-inch deals, 12s. 6d. per 100 superficial feet.

Spruce 1-inch deals, 12s. 6d. per 100 superficial feet.

Larch 1-inch deals, 16s. per 100 superficial feet.

Lath (S. pine), per 1000 superficial feet, 6s.

Paling rails, 3½ × ⅜-inch thick, are sold at 1d. per lineal yard throughout Scotland generally.

Larch posts, 3½ inches by 3½, of best quality of wood, are generally sold at about 1d. per lineal foot; and round posts, from 3 to 4 inches in diameter at small end, are usually sold at a quarter less, in consideration of the wood being of inferior quality.

Having cited several examples of the value and productiveness of wood, in the form and state of plantation, and also the prices it commands in the manufactured state in the principal markets, we shall next endeavour to shew the general leading purposes to which it is applied.

Scots pine wood being the most common, plentiful, and extensively used, it is difficult to say in what particular branch of business or manner of consumpt the greatest part of it is consumed, especially as the trade in wood is so varied and fluctuating. The chief demand, however, for Scotch pine timber during the past ten or fifteen years, has been for railway sleepers, for which purpose there has always been an open market, and ready demand, although the prices given for railway sleepers only allows to the grower from 5d. to 6d. per cubic foot for his rough wood. Next to sleepers, the great demand and open market is for staves, and wood for packing boxes. Wood of this description realizes to the proprietor only from 2½d. to 3d. per cubic foot; but the wood used for this purpose being generally below timber size, is not sold by the cubic foot, but by lineal measure, or so much per dozen; this will appear obvious from the circumstance, that only 35s. is derived per 1000 superficial feet for ½-inch staves in the Glasgow and Newcastle markets, which requires 2¼ cubic feet of wood, 12 feet long, and 6 inches on the side of the square (minus the bark), to produce 1000 feet of staves ½-inch thick, or 58½ cubic feet is required to produce the same quantity of staves, of the same thickness, when the tree is 8 inches on the side of the square, instead of 6. In order, therefore, to manufacture wood into staves, to the greatest advantage, it must be selected of the size most suitable for the purpose.

The wood consumed for package boxes and barrels of various descriptions in Newcastle alone, for exporting soda and other dry goods to India and the colonies, is great almost beyond comprehension. Except native Highland Scotch pine, and that of some of the oldest plantations in other parts of the country, and situated upon dry ground and high exposure, little of it is used in important or substantial buildings, owing to the common objection of its liability to worm-eat; but it is fully admitted that the best quality of Scots pine, as is testified by its duration and partial preservation in buildings two centuries old, is equal, if not superior, to wood imported from foreign countries; and it is also to be regretted that many more of our bleak heath-covered mountains are not clothed and enriched with Scotch pine, which, although of slower growth than upon good soil and lower altitudes, is of better quality, and would continue to grow for a century or more, when their more favoured brethren have succumbed to the ordeal of disease and death. Upon most estates, great quantities of Scots pine wood is used for various descriptions of fences, embankments, and other works, and it is now found, after a lengthened trial, that by submitting it to an embalming process, by steeping it in the oil of tar or creosote, the very softest and most worthless descriptions of it are rendered almost as durable as larch, at a comparatively trifling expense.

Larch is at present, of all others of the coniferous tribe, most esteemed as a serviceable tree for supplying wood for out-door work; and the purposes to which it is applied are almost innumerable, and rapidly increasing. For railway sleepers it is highly esteemed, and it is also in great demand for fencing purposes.

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For out-door work, it is considered the most durable of all descriptions of wood. The lengthened period that some larch posts have stood is quite surprising, some of which are known to the writer to have stood nearly forty years, than which there can be no better proof of its durability. There are few purposes to which the other pines may be applied to which larch may not be applied with greater advantage. The only well-known and lamented defect of the larch is its liability to warp and twist, which is principally due to its peculiar mechanical structure. Trees grown in an exposed site are much more liable to twist than those grown in a sheltered situation; and one of the best proofs of a tree being exempt from twisting is that of the pith being directly in the centre of the tree.

For ship and boat-building, larch has for nearly a century past been very generally used, and for this purpose it has given much satisfaction.

The knees used for supporting the decks, which require to be of the best and strongest of timber, are most esteemed when of larch. The planking of the decks of first-class vessels is also frequently done of larch.

Oak is most extensively used for ship and boat-building of all other descriptions of timber, and none is found to answer so well; but hitherto its application has been less universal on two considerations—the first, is its liability to contract dry-rot in certain parts of the vessel; the second, is that of iron being used instead of wood; but notwithstanding all this, there is a large consumpt of oak in the building of vessels, and the largest quantity and best description finds its way to the dock-yards.

Much furniture is made from oak; and the fittings and general wood-work of most of the principal buildings of the country are either wholly or partly of oak, some of which have been submitted to a certain steeping process, thereby changing its colour.

Agricultural implements, where much strength is required, are less or more constructed of it, especially such as wheels, shafts, and the principal frame-work of carts. Its sap wood is extensively used for plaster-lath; its bark, in the preparation of leather; its oak galls, in the manufacture of ink; its saw-dust, in the curing of fish; its acorns, for the feeding of swine; and its leaves, for litter and manure.

Birch is always in good demand, and realizes prices which pay the proprietor handsomely, especially if he has sufficient quantity of it in one district to warrant the setting up of a manufactory in its vicinity, for converting it into bobbins, reels, broom-heads, and similar ware for the market. Large quantities of it are transported to Glasgow and Paisley, where there is always an open and ready market, at prices varying from 18s. to 24s. per ton. Birch of large size and superior quality, fit for furniture-making, realizes, according to quality and peculiar grain of the wood, from 2s. 6d. to 5s. per cubic foot. The small branches or spray of the birch is in demand for broom-making, which are used extensively in stables, distilleries, and breweries; for street sweeping, garden walks, and carriage roads. Sixpence per faggot (a bundle four feet in girth) is the common price, delivered in town. Birch bark is increasing in demand since larch bark became scarce, and the prices obtained for it are from 50s. to 60s. per ton.

Willow is eagerly sought after by millwrights and machine-makers, for certain parts of whose work it is admirably adapted, being light, elastic, and durable for such purposes; from 1s. 6d. to 2s. 6d. per cubic foot is obtained for clean cuts.

Poplar—for this description of wood, its present chief demand is for brake-block for railway purposes, for which 1s. 6d. to 2s. per cubic foot is given. It is also in demand as boards for bed-room floors, its having a dead sound, and being almost incombustible, together with its great durability, are its chief recommendations for this purpose. Lining for stone; cutting boards for shoemakers, saddlers, &c.; palisade palings, plaster lath, and deals for weather boarding, together with its extensive use in the manufactory of hats and hat boxes, are among the principal uses for which it is employed; but it would doubtless be used for others, such as the manufactory of paper (for which it is well adapted), but

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for its scarcity. Its bark contains tannin about equal to birch, and its copse wood pays handsomely in the neigbourhood of potteries, where its use is for the manufactory of crates.

Lime tree is used for purposes similar to poplar and willow, but also for purposes for which they are unsuitable, such as wood engraving and turnery. Its inner bark forms the fibre of our mats imported from Russia, but which might as well be manufactured at home, as it differs in no important respect from that procured from abroad. Its charcoal, which is used in the manufacture of wire and iron, is considered the best of all sorts.

Alder, like poplar, is in request for brake-blocks, and is also extensively used in the manufacture of clogs and pattens, for which purposes it is well adapted. It is also peeled and made into charcoal for the manufacture of gunpowder, for which purpose it is superior to any other description of wood. It is also extensively used in the manufacture of toys, and certain parts of machinery; and its bark is also valuable for tanning purposes, for which it realizes a price similar to birch.

Sweet chestnut is a valuable wood for many purposes. It is equal to oak, and for some purposes even superior to it—such as gate pillars, fencing posts, &c.; it stands equally as long, and in case of young trees of either species, that of the sweet chestnut stands longest. It makes excellent lath, and splits readily for that purpose, if clean grown.

When introduced into ships by misapprehension, instead of oak, which it much resembles, it has proved equally durable. As timber in buildings, it stands better than oak, being less liable to worm eat. It has been found, on taking down old buildings constructed partly of sweet chestnut and partly of oak, that the former was of better preservation than the latter. Its bark also contains a considerable amount of tannin; and as a fruit-bearing tree, none in the forest is equal to it, or pays so well, especially in England, where a large tree will produce over half-a-bushel of clean nuts, worth about 4s. in the London market.

Sycamore—for certain description of the wood higher prices are given than for any other of British produce. As much as 5s. per cubic foot is given for it, if suitable for making musical instruments, and even 3s. 6d. per foot is realized for certain pieces for turnery ware. Bobbins, reels, and other ware, for manufactory purposes, is made from the smallest wood, so that none of it is either wasted or unsaleable; hence, from these considerations, there is much inducement for planting sycamore.

Ash.—The ash has been termed the poor man's tree, probably from the circumstance that at one time his whole stock of agricultural implements were made from it, which no individual tree would so well make. It combines strength of fibre with elasticity, in a remarkable degree; and a great advantage is, that the wood of the ash, from that of the sapling a few years old to the monarch of a century, is alike valuable and useful. For making handles to tools, where strength, lightness, and elasticity combined, are required, no wood is so valuable. Coach-builders use it extensively, and likewise mill-wrights, wheelwrights, carpenters, cabinetmakers, coopers, joiners, ship-builders, and tool manufacturers. Some parts of the ash are beautifully and richly grained, and are held in high estimation by cabinetmakers, and fancy prices are given for such choice pieces. For fuel, there is no wood better adapted, and it burns equally well when green as when seasoned.

The laburnum, though scarcely entitled to the place of a forest tree, is yet of no small importance in an economic point of view. For various articles of turnery, no wood is more suitable—such as handles, knobs of drawers, egg cups, and fancy ware—for all such articles it possesses peculiar advantages, and worms will scarcely penetrate it. As an example of this, we saw a few days ago a spinning-wheel, known to be two hundred years old, which was as free from worm-eat as if it had been made yesterday. The sap wood of it, however, was so far gone as to crumble at the touch. Pulley-blocks, rollers, &c., where hardness and smoothness form the principal requirements, for which no wood is so suitable; and it also contains an oil which tends greatly to preserve the wood.

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The hornbeam is an important, but unassuming tree, and seldom allowed the opportunity of proving what it might become under favourable circumstances; but enough is known of it to give it a high recommendation as one of the finest and most elegant of furniture producers. In a nobleman's house, known to the writer, there is furniture made from the hornbeam equal in elegance and beauty to any in that house. Its waviness surpasses that of the birch, its colour equals the maple, and its lustre that of the satinwood. From what we have seen of the hornbeam, and furniture produced from it, we feel satisfied that it is well entitled to an important place in the woodlands.

The evergreen oak, from its difficulty and expense of rearing, cannot be recommended for general planting. Yet, on account of its beauty at all seasons of the year, it is not only entitled to the care and attention demanded, but, considering its unrivalled beauty in articles of furniture, it deserves the first attention for that purpose alone. The finest furniture, without exception, we have ever seen, is that made from evergreen oak, and to those who have not had the opportunity of seeing such a pleasing sight, we would recommend them to embrace the opportunity of doing so, when opportunity is afforded.

The holly is a valuable wood for turnery purposes; and from its pure whiteness, which contrasts well with wood of darker colour, commends itself on this account for various articles of furniture.

There is yet another description of wood (coppice) which demands a passing notice, as it contributes in some degree, less or more, to make woodlands profitable; but want of space forbids us entering upon it here. Neither does it fall (properly) to be considered under this head.

There is yet one important article of wood produce almost entirely wasted or unemployed, at least so far as profit is considered, viz., sawdust. In many districts, sawdust is found to be a cumbrous nuisance, neither fit to be put in the river nor permitted upon the land, as it is supposed in the one case, to kill the fish, and in the other, certified to corrupt and poison the soil, and destroy the crops. Having made some experiments with sawdust, with a view of turning it to profitable account, we shall relate the results, and give the reader the benefit of our experience of the subject, in order that he may be able to perfect that which we have only begun.

Sawdust, possessing as it does, much turpentine, proves hurtful to the land as a manure, and in order to purify it of its injurious properties, we dry it and put it into heaps, with a few dry chips or other combustible materials in the centre. When made up into conical heaps like potato stores, it is then set fire to from the top, allowing it to burn downwards till the whole mass is charred, by putting it through the identical process wood is submitted to for making charcoal for ordinary purposes. This being done, which can be accomplished at a small amount of labour or cost, the charred sawdust is then put under cover, from whence it is taken out as opportunity affords, and put into barrels or tanks, and to it is applied urine from the yard, or it may be from the common urinals. The charcoal not only absorbs, but holds in solution, every particle of the urine, and these attract from the atmosphere certain other gases, till the whole mass contains fertilizing properties nearly equal to nitre; and, so far as experiments have gone, no manure of equal value can be purchased at the same price that this is produced at.

The leaves of the forest may also be turned to profitable account, instead of littering the woods, choking up drains, and soiling roads, drives, and walks: they may be converted into manure at only the expense of collecting.

SUMMARY.

1st, The stem or trunk of the tree is used for building houses and constructing ships, making implements of husbandry and machines, producing materials for the making and working of railways, &c.

2d, The branches, amongst other purposes, are used for fuel to warm the body, cook the food, and render hearts and homes comforable and cheerful.

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3d, Small wood is used for mining purposes to support the roofs of coal pits, fence our fields, and protect our crops.

4th, Plantations shelter the country, break the fury of the wind, and enable stock to live and thrive, which, but for plantations, could scarcely exist.

5th, Roots, chips, bark, sawdust, and leaves, are converted into manure, for producing crops by which the million is fed.

6th, Trees, unlike flowers or fruits of the garden or field, require comparatively little attention beyond planting and thinning, will go on growing while men are sleeping, if only, in the first place, rightly planted, and in the second place, receive due and proper room to grow.

7th, Trees have a period of ripeness or maturity like most other products of the soil; and there are also times when advantageous sales can be effected; and otherwise, all of which times and opportunities require to be watched and embraced.

8th, There is little likelihood within the present century of the price of wood greatly changing, seeing that free trade prevails, and transport is now easily and cheaply accomplished, so that where scarcity or demand is, thither the produce can be carried, and the wants of the country by these means be uniformly supplied.

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XXII.—*ON THE PRINCIPAL TIMBER TREES INTRODUCED INTO GREAT BRITAIN FROM THE EASTERN SEA-BOARD OF NORTH AMERICA.*

BY J. E. BROWN, CRAIGMILL, STIRLING.

EVER since communication with the eastern shores of America began, they have been the chief source from which Great Britain has been supplied with an enormous quantity of the imported timber which she annually consumes; and when we consider that, of all the countries in the world, America can produce the greatest variety of useful trees, and the finest quality of timber known, it is not surprising that the introduction of forest trees from America into these islands has occupied the attention of our Arboriculturists. Up to the present time, I believe that almost all, if not the whole, of the really useful and economic trees found along the eastern sea-board of North America, have been introduced into this country, from time to time, during the last two centuries. As a whole, the trees introduced have not done so well as might have been expected; although, indeed, several kinds have succeeded remarkably well. This failure has, I believe, been more the fault of the planters than of the unsuitableness of the trees to our climate, and is to be attributed chiefly to want of attention to condition of soil and situation, so as to adapt these, as nearly as possible, to those in which the trees are found in their natural state. It is not, however, to be inferred, that although the additions to our Arboretum from America have not as yet been so successful as is desirable, that they will always remain so. As I am convinced that some of the American trees are yet to form an important part of the woodlands of Great Britain, it is therefore desirable that we should possess some reliable information in regard to the soils and general conditions in which we find the different kinds in their native forests, so as to be a guide to planters in this country.

Having, therefore, when on a tour through Canada and the United States, some two years ago, made a point of visiting and inspecting the great forests lying principally along the eastern sea-board of the country, and along the valleys of the St Lawrence and Ottawa Rivers, and noting particularly the different conditions of soil and situation in which I found the several kinds to grow healthily; and having seen to what purposes, economically, the timber of the different species is applied in America, I shall endeavour in this report to lay these points down as a guide to our future cultivation of American trees in this country.

I therefore proceed to refer to the chief kinds of trees found growing on the parts to which this report has reference; and in attending to this, my principal object will be to point out the character of their natural sites, as this seems of the most importance to planters in this country. Afterwards, I will give a few remarks as to how American trees should be dealt with in Britain, in order to their better success in future.

Black American Spruce Fir (*Abies nigra*). *Introduced into Great Britain in* 1700.—In its native soil, this forms a very graceful, tall, cone shaped tree, its dark foliage producing a fine contrast among trees of a lighter shade. In its healthiest state, I found this tree growing on a flat-lying, cold-bottomed soil, with stagnant water here and there. In such places it had attained its greatest dimensions, being from 70 to 80 feet high, and 18 inches in diameter at 5 feet from the ground.

Its timber is extensively used for flooring purposes, and is shipped largely from Quebec for the Irish market.

It has not succeeded in this country to any important extent. To thrive well, it should be planted on a low-lying, dampish, sheltered site.

White Spruce Fir (*Abies alba*). *Intro-*

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duced into Great Britain in 1700. The largest specimens of this tree I found were about 45 feet high, with a diameter of 15 inches at 5 feet from the ground. I found it growing healthily on the slopes of ravines, where it had soil of a dry open-bottomed character, and where moisture descended from wet parts at a higher elevation.

The wood of this tree is used for the same purposes as that of the preceding fir. It is perhaps worthy of note, that the roots, owing to their toughness and durability, are used by the Indians in sewing their bark canoes.

It cannot be said to have done well in this country, as it has only as yet attained a comparatively small size.

Hemlock Spruce Fir (*Abies Canadensis*). *Introduced into Great Britain in* 1736.—This tree grows to a height of fully 100 feet, with a diameter of from 4 to 5 feet at bottom. The largest specimens I have seen were on the edges of swamps, where the soil is deep, with a constant supply of moisture to their roots. I have also met with it on dry and poor soils; but in such places I invariably found it to be of smaller dimensions, and seemingly, as it were, not at home. It, therefore, evidently succeeds best on soils of a deep and rich character, on the edges of wet parts.

The bark is used as a substitute for oak bark in tanning purposes. The quality of its timber is coarse, and is therefore only cut up into rough deals or planks, in which shape it is now being extensively used in the construction of the plank roads of America, owing to its being more durable than the wood of the pine in such situation.

We have not yet succeeded in growing this tree to respectable timber size in this country, although we have some very good specimens, such as those at Invermay in Perthshire, and Buchanan House in Dumbartonshire.

Sugar Maple (*Acer saccharinum*). *Introduced into Great Britain in* 1735.—I have found this tree from 80 to 100 feet high, and even upwards, with a diameter of from 30 to 40 inches at 4 feet from the bottom, on soils of deep, rich, vegetable mould, close to swamps, on flats, the banks of rivers, and in ravines. It is found in a healthy condition on different sites, on soils differing widely from each other, but all having a tendency to be deep, rich, and free from actual wetness. Where found on absolutely wet or dry soils it was always small, and stunted in its growth.

This is a favourite tree in America, and no man will readily take a farm which has not part of its "bush" composed of this tree, as from its sap, in early spring, large quantities of excellent sugar are made. It is extensively used in the making of furniture, for which there is no kind of wood better adapted; it is also a favourite article of fuel. In the autumn, its decaying leaves give a gorgeous effect to the American forests.

American Chestnut (*Castanea vesca*). *Indigenous to our own country as well as America.*—I found growing on good, rich, loamy soil, and on sites similar to those occupied by the sweet chestnut of Europe.

Its wood is used for fencing purposes in America, and for house building where it can be procured; but it is no where plentiful.

The Tall Birch (*Betula excelsa.*) *Introduced into Great Britain in* 1767.—This is a beautiful tree, and grows to large dimensions, on dry soil of a deep and rich character. On such soil, I have seen it about 90 feet in height, with a diameter of over 2 feet at the bottom. I have also found it on wet spots, and on poor land, but then only comparatively small.

Its timber is extensively used, and is admirably adapted for the purposes of the cabinet-maker.

The specimens of this tree found in Britain have not yet attained a very large size.

The Paper Birch (*Betula papyracea*). *Introduced into Great Britain in* 1750.—On dry and poor soils, such as on the slopes of ravines and banks, this tree grows well; there I have seen it about 50 feet in height, with a diameter of 15 inches at bottom. It does not succeed well on rich or wet soils.

Is used for the same purposes as the tall birch, and, like it, has attained to only trees of small size in Great Britain.

American Hornbeam (*Carpinus Americana*).

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Introduced into this country in 1812. — Is found on all soils of a dry and poor character, and of a sandy nature, where it attains the height of 40 feet, with a stem of about 18 inches diameter at bottom.

In America the timber of this tree is used for furniture purposes.

American Beech (*Fagus ferruginea*). *Introduced into this country in* 1766.—Grows frequently to a height of 120 feet, with a stem of 4 feet in diameter at bottom ; it never succeeds well where found on soils of a wet or strong character.

Resembles very much the beech of our own country, both as regards its nature and appliances ; but it has not yet grown to any great size here.

Elder-leaved Ash (*Fraxinus sambucifolia*); *Walnut-leaved Ash* (*Fraxinus Juglandifolia*); *Downy Ash* (*Fraxinus pubescens*). — The sambucifolia was introduced into this country in 1800, the Juglandifolia in 1783, and the pubescens in 1811. When in a healthy condition I have chiefly found them growing on rich and deep lands, with a moist and cold bottomed subsoil. I have never met with these kinds on dry or poor soil.

The ash is rather a common tree over America, and is extensively used for railway purposes, and also for those of the turner, especially the wood of the walnut leaved, which is sometimes called the black ash. The toughness of this kind is remarkable, so much so that pillars can be turned out of the solid block, which will neither split nor warp.

These kinds have only attained the size of small trees in this country.

Butter Nut Tree (*Juglans cinerea*). *Introduced into Great Britain in* 1656.—I found this tree in its healthiest state growing on deep rich loam, where it had attained the height of about 70 feet, and a stem of from 2 to 2½ feet in diameter near the bottom. A soil of a rich loamy character in the vicinity of a swamp or river seems to be the place most suitable for this tree. It is almost always found in its natural state along the banks of rivers and creeks, and never, that I have observed, is it to be found on poor or dry soils.

Its wood is admirably adapted for furniture making, and resembles very much that made from the other kinds of walnut trees.

Shell-barked Hickory (*Juglans alba*). *Introduced into Great Britain in* 1629.—I have never seen this tree on soils the least wet, but found it luxuriating on a soil of a dry and rich loamy character.

The timber of this is also used for furniture purposes.

The tree has not grown to any considerable size in Great Britain.

Bitter Nut Hickory (*Juglans amara*). *Introduced into this country in* 1800.—The natural conditions of soil and site in respect to this tree are similar to those of the shell-barked hickory.

Its wood is also used for making furniture.

Has only grown to the size of a small tree in this country.

Tulip Tree (*Liriodendron tulipifera*). *Introduced into this country in* 1663.—In warm situations, where the soil was deep and rich, I found this tree growing luxuriantly, and presenting a stem in height of about seventy feet, with a diameter of fully twenty inches.

It is only fitted to be an ornamental tree in this country, and cannot be said to be of any economic use, as its wood is too soft to be applied to anything permanently useful.

In some of our English parks, such as Longleat and Stoneheath, Wiltshire, where they are nicely sheltered from the winds, many specimens of this tree may be seen growing very healthily, and of considerable size. It is a very beautiful tree, and deserves to be more planted than it is, both for sake of its flowers and foliage.

Tamarack, or American Larch (*Larix macrocarpa*). *Introduced into Great Britain in* 1760.—This tree luxuriates in swampy parts of the country. I have seen a large district of swamp or marshy ground wholly occupied by an abundant crop of this tree, where the land was flat and cold-bottomed, and in some places covered with water. In

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such places, although the greater part of the crop grows on parts which were covered by water, still the trees growing in the skirts of the swamp were by far the finest specimens, some of which, I observed, had attained the height of fully 100 feet, with a stem of nearly 3 feet at the bottom. The soil most suited to its healthy development is therefore one of a wet and cold nature. It is sometimes to be seen growing on dry banks, but never to any considerable size.

Its wood is of excellent quality, very durable, and exceedingly well adapted for railway ties, &c. Judging from the out-door purposes for which I have seen it used, and the number of years it had stood out, I think it is even more durable than the European larch. The tree has, however, not attained respectable dimensions in Great Britain; the largest I know of it is at Brahan Castle, in Ross-shire.

Weymouth Pine (*Pinus Strobus*). *Introduced into Great Britain in* 1705.—This is what in Canada is called the "White Pine," and is the chief economic tree of the country. Its timber is very valuable, being easily wrought, comparatively free from knots, and very durable; and is a species of wood of which Canada has an almost unlimited supply. It is exported to Britain in the shape of masts, deals, laths, and squared timber.

Very fine specimens of this tree may be seen all over Canada, especially in the valley of the Ottawa. There I have seen specimens upwards of 200 feet in height, with a diameter of stem over 6 feet, about 6 feet from the ground. I have no doubt whatever that, if care was taken in planting it in this country, it would make a tree of no mean dimensions. Let us see, therefore, in what condition of soil it is found in its natural state. This I found to be of a deep sandy loam, resting on a gravelly bottom, perfectly dry. Where I found them on such a soil they were the finest specimens, and the timber was of the finest quality. I have also seen them growing on flat parts of the country, where the soil was of a very rich character; but there, although the trees grew rapidly, and attained large dimensions, their wood soon decayed, and the trees seemed to die at a premature age.

When attention is paid to soil and situation, it seems to grow very well in this country. I have seen several specimens in Great Britain containing, I should say, fully 50 cubic feet of timber.

Red Pine of Canada (*Pinus resinosa*). *Introduced into this country in* 1756.—This is another tree the timber of which is valuable in an economic point of view, and is largely exported to this country. It is comparatively rare, except in the Ottawa district, where it abounds pretty plentifully. In Lower Canada, it is only found here and there on rocky, dry paths. It would succeed very well in this country if sites were chosen suitable for it, similar, as far as possible, to that in which it is found in its natural state. This I found to be on dry ridges, with poor gravelly soil. It is never found where there is the least approach to wetness, nor where the soil is at all of a rich character.

Balsam Poplar (*Populus balsamifera*). *Introduced into this country in* 1692.—I have found this tree always growing on a deep rich loam of a dry and light character.

Specimens of this tree are too plentiful all over this country to require any further remarks on it.

Small-leaved Trembling Poplar (*Populus trepida*). *Introduced into this country in* 1812.—Grows, in its healthiest condition, on dry and poor soil on banks and ridges. Its timber is of no commercial use, although the tree attains considerable size.

Large Tooth-leaved Poplar (*Populus grandidentata*).—The peculiarities of this tree are in all respects similar to those of the Populus tremula.

Necklace Bearing, or Black Italian Poplar (*Populus monilifera*). *Introduced into this country in* 1772.—No absolute rule can be laid down as to what kind of site it grows healthiest on, only that it seems to prefer deep rich lands, with a medium betwixt wet and dry. I found this tree plentiful on the borders of Lake

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Ontario, where the land is of a deep and rich character. It is the most valuable of all the poplars, and is too well known to require comment. It has attained very large dimensions in Britain, and is now becoming a very valuable tree.

Ontario Poplar (*Populus macrophylla*). *Heart-leaved Poplar* (*Populus candicans*). *The macrophylla was introduced into this country in* 1820, *and the candicans in* 1772. —I have found both these on the valley of the Ottawa, but neither of them seem to attain important dimensions of timber. The specimens I saw grew on dry sloping banks, but were small trees only.

Blunt-lobed-leaved Oak (*Quercus obtusiloba*). *Introduced into Great Britain in* 1786.—I found this tree to grow best on a dry light sandy loam, on the banks of rivers. Its wood is of good quality, and is used in America for every domestic purpose. From the trials which it has had in this country it seems to be adapted to grow in our climate. We have fair average specimens of it all over Britain; and besides its qualities as a useful tree it is also a very ornamental one.

White American Oak (*Quercus alba*). *Introduced into Great Britain in* 1724.—This is doubtless one of the best of the oaks, and is of very large dimensions along the more fertile districts of Canada. Its favourite site is on the flat lands by the sides of rivers and water-courses, where the soil is deep, strong, and inclined to be somewhat cold-bottomed. It is also to be found growing on poor and dry soils, but on such it never attains large dimensions. The quality of its timber is perhaps only second to that of British oak; and it is this oak tree which forms the great standard of our importations of oak from America. It has attained a size of fully 60 feet in height in this country, and bids fair to become one of our standard oak trees. It is also a very ornamental tree.

There are a great many oaks which have been introduced into this country from America; but I have only taken up the two principal ones, as they are likely to supersede all the others in an economical point of view.

The Arborvitæ (*Thuja occidentalis*). *Introduced into Great Britain in* 1596. In America it is commonly called the "White Cedar." To those who have not seen this tree in its native grandeur, the name implies a mere bush, fit only for growing in our gardens and shrubberies. I believe, therefore, that many will not credit me when I say that I have seen them about 100 feet in height, with a stem of between 4 and 5 feet in diameter at the bottom, with beautifully spreading branches. It is a very graceful tree and deserves particular note. Perhaps it may be asked, why has it not grown to such a height and general dimensions in this country? The reason that the tree has not attained more than the dimensions of a bush here, is simply that its *wants in regard to soil and situation* were not understood when planted. Let us see how it is in this respect as found in its native state. I found it invariably luxuriating in the *wettest* parts of the country; in swamps, creeks, and on the flat and wet banks of rivers, sometimes wholly occupying these. Now, how do we find it planted in this country? Almost invariably on dry and exposed places, where of course it never can succeed. Indeed it is a wonder that they grow at all as they are treated in this country. It would not do, however, to plant them actually in the midst of water here, as it would then be too cold for them, and they would most probably die altogether. Our climate is not warm enough to grow them on land saturated with water. The site which I think most suitable for them in this country is on low-lying flat parts, well sheltered, and within the influence of water, but not absolutely in it, although in its vicinity.

The timber of this tree is extensively used for fencing purposes in America. It is light and durable, and I think might be judiciously used in this way in this country.

I have seen very fair specimens of it in England, where they had been planted in suitable situations.

American Lime Tree (*Tilia americana*). *Introduced into Great Britain in* 1752.—Grows

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to large dimensions on soils of a dry, rich, and deep character.

In some cases this tree has made fair average progress in this country.

White American Elm (*Ulmus americana*). *Introduced into Great Britain in* 1752.—This is a fine tree, and grows to a very large size in the American woods. When in its healthiest state, and where it has obtained its largest dimensions, I found it growing on flat sites, with a soil deep and rich in vegetable matter, and seemingly with a wet subsoil. On such places I have seen them 100 feet in height, with a diameter of 4 feet at the bottom of the stem. I have never seen them growing to any great size on dry soils, or on soils thoroughly wet.

It has only as yet attained the size of a small tree in this country.

Balm of Gilead Fir (*Picea balsamea*). *Introduced into Great Britain in* 1696.—This tree I found growing on lands of rather a cold-bottomed character, on flats by the sides of rivers. I have seen it fully 60 feet in height, with a stem of about 2 feet in diameter.

Its timber is used in the shape of deals in America. It has not succeeded very well in this country.

Having, in the foregoing, referred to the principal kinds of timber trees which I found growing on the eastern portions of North America, I now come to make a few remarks as to how they should be dealt with in Great Britain, in order to their better success in this country in future.

It is to be inferred from my remarks, in respect to the different kinds, that comparatively few of the American trees have as yet attained respectable timber size in Great Britain, that this is attributable chiefly to want of attention to condition of soil and situation, so as to adapt these, as nearly as possible, to those in which the trees are found in their natural state; and that, if more attention had been paid to the peculiarities of each kind when planting them, our success in their cultivation would have been greater and of a more decided character. For example, why is it that in this country the American arborvitæ, generally speaking, only attains the size of a very small tree or large bush? The answer is, simply because the tree in its natural state grows in deep, rich, and naturally wet lands, with perfect shelter all around; while in Britain, these conditions are generally reversed, as we find it generally planted in poor, thin, and naturally dry lands, and frequently on exposed sites. This explains the cause of our want of success in the cultivation of the arborvitæ; and the same remarks may be said to apply in degree to our mode of cultivating all the other kinds. The great promoter of the growth to perfection of all the American trees named, is shelter. This is indispensable to success in their cultivation, whether here or in their own localities. I have often remarked, while on my tour in America, that wherever a tree, or it might be a few trees, stood alone in a large open clearing or field, where they were exposed to storm, they were invariably of a short-stemmed, branchy-topped, and somewhat stunted character, very similar to the same kinds when planted out under similar circumstances in our own country. Thus proving that the American trees, even in their own native habitats, do not attain large dimensions when growing on exposed sites.

All the kinds named in this paper attain their greatest dimensions when grown on soils and sites such as have been described in reference to each respectively, and when perfectly sheltered from winds by masses of other trees all around.

Now this state of things can be secured here as well as in America; for in the central parts of a large wood in Britain there is as much shelter obtained as in one of equal extent in America.

In order to ensure better success in future, in regard to the cultivation of the kinds of American trees named and referred to in this paper, we have only to plant them in soils and sites similar to those in which they are found naturally, and to secure shelter and warmth to them by planting them in large masses, either among themselves or with

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other kinds. Our climate is no drawback to the healthy devolopment of the trees found on the parts of North America referred to, as the success of several of them prove. For example, we may refer to the poplars. In this country, the American kinds of these attain equally as large dimensions as they do in their native habitats. Now, what is the cause of this? It is that we have given the poplar the soil and site congenial to it; that is, have we planted them in deep, heavy, cold-bottomed lands, and in sheltered sites, since they have done well with us? If we had planted them on dry poor land they would not have succeeded. Hence, in conclusion under this head, if each kind be attended to accordingly, it cannot fail to succeed equally well.

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XXIII.—*ON THE DIFFERENT AGES AT WHICH THE VARIOUS SORTS OF TIMBER TREES USUALLY GROWN IN SCOTLAND MAY BE MOST PROFITABLY FELLED IN DIFFERENT SOILS AND SITUATIONS.*

BY WILLIAM GILCHRIST, FORESTER, CLUNY CASTLE, ABERDEEN.

AT no period in the history of Arboriculture could the above subject have been more appropriately brought before the members of the Scottish Arboricultural Society than the present, as we are living in an age when the great question that affects all investments is, what profits will they realize? and at what period may these profits be most profitably realized? Science and art, in the multiplicity of their inventions, are brought to the aid of the manufacturer, so that his goods may be brought to the market in the shortest possible period.

Agriculture, through the same causes, has within a very short period undergone almost a magical change, her implements and machinery have been revolutionized, and steam has been brought to the aid of, and threatens to supersede, horse-power in the cultivation of the land.

In these improvements Arboriculture has also shared, by the necessity that, through science, has been shewn for thinning and draining plantations, but more particularly by the chemical preparations that from time to time have been introduced for the preservation of wood. These chemical appliances being still on their trial, it would be premature to speak particularly of any of them; but there is reason to believe that when they come to be better understood and applied, the value of "home" grown timber may be enhanced.

In considering this subject, and before enumerating the various sorts of timber trees usually grown in Scotland for profit, it will be well to take a general view of what are the considerations that ought to be taken into account in deciding at what time a crop of trees can be most profitably reaped, and also some things that ought to be taken into account in calculating the profit of a crop of wood.

As a general rule, wood, like any other crop, should not be reaped until it has reached maturity, or attained to full size; nearly all our timber trees require many years, while some of the varieties require upwards of a century to arrive at maturity. But granted that some sorts of trees take upwards of a century to arrive at maturity, a question comes to be, is it not possible to realize the value of these trees more profitably before they come to maturity? With some sorts of trees, in certain districts, it is, and with others it is not, as a great deal depends upon local circumstances, and the demand that, for the time being, exists for the various sorts of timber. The demand or market constitutes an element on determining at what time a crop of wood can be most profitably reaped. For instance, in some parts of the country, and especially in mining districts, fir trees suitable for prop-wood can be grown and felled at from twenty-five to thirty-five years old, and at that age realize greater profits than they would do if allowed to grow to double the age; whereas in other parts of the country, where the situation may be far from mining districts, and from 20 to 30 miles from a seaport, the same class of wood would hardly repay the expense of cutting and conveying it to the market; so thus in the one situation wood *can* be grown and felled profitably before reaching maturity, in the other it must have reached such a size as will fit it for being manufactured in the neighbourhood, and then sent to the market in a manufactured state. Again, in some districts of England, copsewood grown for hop-poles, crate-wood, fuel, &c., is one of the most pro-

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fitable wood crops that can be produced, while in the greater part of Scotland the returns from crops of that kind are very inconsiderable.

The past management of wood must also be taken into consideration in deciding as to its future. It is a common thing to see a plantation that has been neglected, and the trees allowed to get overdrawn until they have come to be "mere spars." Instances of plantations could be given where, at from twenty to thirty years old, the trees are so much overdrawn that all hope of their becoming timber trees is gone. Therefore, although they cannot be said to have reached maturity, they are only occupying the ground without adding to their value. To say of such a crop that it should be allowed to stand until it was sixty, seventy, or perhaps one hundred years old, would only be allowing a crop to remain on the ground for thirty or forty years after it could have been most profitably reaped; for, be it remembered that a neglected crop of trees, after they come to a certain state, improve very little in value; whereas woods that are grown in a suitable situation as to soil, and have been well managed in their earlier stages, at thirty or forty years of age begin to add materially to their value each successive year. The profits of such trees cannot be fully realized until they have come to maturity.

In high-lying and exposed situations, timber trees require more time to come to maturity, but they produce better quality of timber than is produced in low-lying and sheltered plantations. It may be safely said that trees that would take 100 years to come to maturity in high-lying districts would require not more than sixty or seventy years in low lying and sheltered districts; yet the quantity of wood in the latter would be more than in the former.

The situation which a plantation occupies is a very important consideration in deciding when the trees can be most profitably felled; but with the generality of wood managers it is a consideration that is often overlooked. For instance, a plantation may be growing in a situation where the shelter provided by the trees to the lands adjoining is of more value than the mere price of the trees. The same consideration applies to trees grown in belts or hedgerows throughout the cultivated or pastured districts. Therefore it is unfair to expect the timber produce of these plantations or belts to be a profitable investment. They are formed and grown for a double purpose, and the one purpose should yield its quota of profits as well as the other.

In extensive woodland districts, the actual value of the wood may be all that requires to be taken into account, and in these woodland districts fair profits are generally realized; but it must be borne in mind that the value of ground in these districts is very moderate, consequently very little is charged against the plantations for annual rent. The soil is also often better suited for the growth of timber trees of the fir tribe than it is in the districts that are more cultivated. Plantations are to be found throughout the greater part of the cultivated districts of England and Scotland, varying in extent from 1 to perhaps 100 acres, and consisting of different varieties of trees; and if their past histories could be told, the objects for which they were planted, and the purposes for which they have been used, would be still more various. Some may have been formed for ornament, some for shelter, others for game preserves or fox-covers; a still greater number may have been formed to cover irreclaimable land, or to please some individual fancy; while the minor number have been formed for the actual profits to be derived from the wood, or as profitable investments. Whatever may have been the object in planting, I think I am warranted in saying that the greater number of them have been used for other purposes than the cultivation of timber trees. Most plantations are used to afford pleasure to the proprietors or their friends at one time or other.

If it has been found that the shelter produced by trees adds an appreciable value to the lands adjoining, I would suggest that, in calculating the value of a crop of wood, the said 10 or 15 per cent. should be placed to the credit of the plantation; and the same

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rule ought to apply to game rents and such like pleasures. If this is not granted as to game rents, &c., the wood manager ought to be allowed to let the plantations for grazing purposes as soon as the trees are beyond the danger of being injured by sheep. By doing this, from 2s. 6d. to 10s. per acre can be realized. That, along with the per-centage chargeable for the shelter produced to the adjoining lands, is no mean consideration in assisting to pay the rental that is yearly chargeable against plantation ground. Some of these considerations are the more necessary, as the wood manager, owing to restrictions being put upon him for the sake of game, &c., is often obliged to do the necessary wood-work during the winter season, and at a great disadvantage. It is often said that wood crops do not pay; but if all these considerations and details at which we have only hinted were taken into account in calculating the returns, I feel assured that wood crops would come to be regarded as a more remunerative investment.

We have already said that some varieties of trees come sooner to maturity, and can be profitably felled at an earlier age than others. This is particularly the case with some of the fir tribe, which, for profitable culture, are the sorts best adapted for the soils and situations of Scotland. The larch, which has been the most remunerative tree ever introduced, will yield fair profits at twenty-five to thirty years old for fencing purposes and prop-wood. At about forty-five years it is good spar-wood, worth from 3s. to 4s. per tree in some districts. If it is growing freely, it should not be cut at forty-five or fifty years old, as it is only after this period that its largest annual growths are made, these sometimes adding from 1 to 2 cubic feet in one season. From sixty to one hundred years, according to soil and situation, I consider to be the most profitable time to reap the value of a crop of larch. It has been estimated that the profits of a crop of larch at that age may realize as high as £500 per acre, and sometimes even more; and I have no doubt but that exceptional cases may be got bearing out these statements. But I feel assured that, taking a general average of the larch plantations in Scotland at the present day, the price per acre at sixty years old would not exceed £150. This is a point that cannot be decided except by carefully prepared statistics. This is well worthy of being considered by the Scottish Arboricultural Society.

Another objectionable point in some of the statements that have been made regarding larch is the price per cubic foot (generally from 1s. to 1s. 6d.) on which the statements or calculations have been based, the prices stated being generally as much as can be got for it when laid down at a seaport; whereas the correct estimate should be the price or value of the wood as it stands in the plantation; or if it is cut, manufactured, or conveyed in any way, it should be stated, and the cost of doing so deducted from the price received.

The finest larch trees are often grown as nurses among hardwood, principally oak, in situations composed of deep alluvial soil, dry and open, with a gravelly subsoil and sheltered situation. Really good larch are seldom got when grown amongst Scots pine. Thin moor soil, with a hard bottom, or poor and stiff clay, with a wet bottom, are soils where the larch will not grow profitably.

The age at which the larch and other trees generally grown for profit, in different soils and situations, can be most profitably felled, will be fully shewn in the Appendix at Table B.

The Scots fir may be felled and used for prop-wood, spar-wood, and timber trees: at sixty years old it has often to be divided into these classes. The profits realized for a crop of Scots fir are not so high as the larch; but it is more generally grown in the north of Scotland, and is a safer crop than the larch. They are often grown together, but neither of them do so well as when grown amongst hardwood, or by themselves in masses. The wood, when far from a market, is sold at a very low price. As an instance, thinnings from a plantation forty-eight years old were sold this season (1869), in lots, by public auction, at the rate of one farthing per lineal foot, or, on an average, about 6d. per tree. Another plantation, rather nearer the market

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was sold at 3s. 3d. per tree at sixty years old, and about 230 trees on the acre. Another plantation, two-thirds larch and one-third Scots fir, seventy years old, sold at £40 per acre. Near to the market, I have sold Scots fir at 1s. 1d. per foot; while at 18 miles from a seaport, 5d. per foot is all that can be got for wood of equal quality.

The Scots fir succeeds in thin moorland and light sandy soils better than any other sort of tree, and on these soils it is really a profitable crop. Where the soil and situation are suitable, it is generally most profitable to grow it to timber size.

The chemical appliances at which we hinted in the opening part of this paper are already working changes in the uses to which Scots fir may be applied. It is now extensively used for railway sleepers, and when chemically prepared is little inferior to the larch for that purpose.

The spruce and silver firs can seldom be felled profitably until they have come to be timber trees. Of course, in situations where they are affected with heart-rot, or any other disease that would prevent their becoming timber trees, the sooner they are felled after the disease has shewn itself the larger will be the profits; and the same rule applies to all timber trees grown for profit.

In damp mossy soils the spruce grows to larger dimensions, and is more profitable than any other tree, with perhaps the exception of the poplars and Huntingdon willow; but in exposed situations, with hard, retentive, clayey soils, it will not grow to be profitable at any age.

The silver fir has not been so extensively grown as the former, but in some situations it attains a greater size in a given time; as a profitable investment, few trees give greater promise. Like the Scots fir, it is being introduced as sleeper-wood.

The ash may be profitably felled at all stages of its growth; but the highest prices are got for it when at a size fit for handle-wood, &c., or for full-grown timber trees of large dimensions; the intermediate size generally being from 4d. to 6d. per cubic foot cheaper than the two former.

The oak can seldom be felled profitably (unless for copsewood) before it is 120 or 150 years old, or at least until its heart-wood is perfected, as the wood, although of a good size—if the heart-wood is not matured—is generally sold from 1s. to 1s. 3d. less per cubic foot than the matured wood, and the difference is even sometimes greater. On the same estate, I have sold oak 120 years old at 3s. 6d. per foot, and at seventy years old at 1s. 6d. per foot; the situations where the trees grew being similar. The same remarks apply to the sweet chestnut.

The sycamore, Norway maple, and birch, are saleable when about thirty years old, being used for the purposes of turnery, &c.; but profitable returns are not got from them until they have come to timber size, and the larger the scantling to which they are grown, the higher will be the price per cubic foot.

Beech and English and Scotch elm, when young, and of a small size, are only sold as *ton* wood; and where the object of planting is to get profitable returns, they should never be planted except in soils and situations that will grow them to full size.

Horse chestnut and lime trees are generally grown more for ornament than for profit; but both can be grown profitably in good soil and sheltered situations, as high prices are got for the wood when of a large size.

The poplars and willows are all very fast growers, and their wood is in great demand at all stages of their growth. When well grown, their wood may be profitably sold from thirty-five to seventy years of age; at about the latter period, the highest profits for them can be realized.

The alder being generally grown on wet swampy ground, and used for turnery purposes, charing, &c., it may be most profitably felled at forty or fifty years old; when once established in the ground, it does not require to be planted again though cut down, as it springs readily from the root, and makes excellent copsewood.

The annexed tables will more fully illustrate our opinions on this subject; but as these are only compiled from individual experience, they must not be taken as a full

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representation of the timber trees grown in the several districts of Scotland; in fact, no individual experience can have much weight on the subject. I would, therefore, suggest to the Committee of the Scottish Arboricultural Society that blank copies of these or similar tables should be sent to all the members of the Society, and let each member fill up the table, so far as his experience goes, and then the Publishing Committee might have them analyzed and published with the Transactions.

Full returns and information on this important subject would then be had, and the subject should not be confined to Scotland, but should comprehend England and Ireland, as members of the Society are to be found in all parts of the kingdom.

Since writing the above, I have learned that returns as to the price of timber were issued by the Scottish Arboricultural Society in the first volume of their Transactions; but as these cannot now be had, they might be again taken up with great advantage to the younger members of the Society.

TABLE A.

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TABLE A, shewing Prices realized for the various sorts of Timber Trees grown in Scotland for Profit, in different situations, as to distance from Markets, &c.

NAME OF TREE.	Wood growing in a Mining district, or within 8 miles of such.				Wood grown within 12 miles of a Seaport.				Wood grown at 12 miles and upwards from a Seaport.				REMARKS.
	25 years.	40 years.	60 years.	100 years and upwards.	25 years.	40 years.	60 years.	100 years and upwards.	25 years.	40 years.	60 years.	100 years and upwards.	
	100 ft.	per ft.	per ft.	per ft.	100 ft.	per ft.	per ft.	per ft.	100 ft.	per ft.	per ft.	per ft.	
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
SCOTS PINE	6 6	0 9	1 0	1 2	4 6	0 7	0 10	1 0	2 3	0 4	0 5	0 7	Inferior quality has been sold at 2d. per foot
LARCH	7 6	1 0	1 2	1 5	6 0	0 8	1 0	1 3	2 6	0 6	0 8	0 10	Extra quality sold as high as 2s. 3d. per foot
SPRUCE FIR	6 6	0 8	0 10	0 11	4 6	0 6	0 8	0 10	2 3	0 3	0 4	0 6	Spruce and silver fir, though used for the same purposes as the Scots pine, seldom realize the price
SILVER FIR	6 6	0 9	0 11	1 2	4 6	0 6	0 9	0 11	2 3	0 3	0 5	0 7	
	per ton				per ton				per ton				
ASH	20 0	2 0	1 4	1 6	15 0	1 8	1 4	1 6	10 0	1 8	1 4	1 6	Ash chiefly used for local purposes
		per ton				per ton				per ton			
ALDER	12 0	15 0	0 10	1 0	7 6	10 6	0 8	0 10	4 0	6 0	0 8	0 10	In the latter district alder is used by carpenters
BEECH	8 6	12 0	0 10	1 2	4 6	7 6	0 7	0 10	3 0	5 0	0 4	0 7	Extra size and quality is sometimes sold at 2s. 6d.
BIRCH	15 0	20 0	0 10	1 0	10 0	15 0	0 8	0 10	5 0	10 0	0 8	0 10	Used for turnery and carpenters; prices variable
ELM (SCOTCH)	15 0	15 0	0 10	1 9	11 6	11 6	0 7	1 3	7 0	7 0	0 4	0 11	Both varieties of the elm are much sought after for crate-wood when young
ELM (ENGLISH)	15 0	15 0	0 10	1 6	11 6	11 6	0 7	1 0	7 0	7 0	0 4	0 11	
CHESTNUT (HORSE)	6 6	14 0	0 10	1 6	5 0	12 6	0 8	1 0	3 6	8 4	0 6	0 10	Not often in the market
CHESTNUT (SWEET)	8 6	25 0	1 9	2 3	5 0	20 0 per ft.	1 6	1 8	3 6	15 0 per ft.	1 0	1 4	When of good quality, draws a high price
LIME	6 6	20 0	1 6	2 0	4 6	0 9	1 0	1 3	3 6	0 6	0 7	0 10	Not often in the market
MAPLE (NORWAY)	10 0	25 0	1 6	3 0	7 6	0 7	0 9	1 0	5 0	0 5	0 7	0 10	Used for the same purposes as the plane
		per ft.											
OAK	8 6	1 3	1 9	3 0	6 0	1 0	1 6	2 6	4 0	0 10	1 6	2 0	Oak has been sold at 4s. 6d. per foot
		per ton											
PLANE or SYCAMORE	10 0	30 0	2 6	3 6	7 6	0 10	1 9	2 6	5 0	0 9	1 4	2 0	Plane has been sold at 4s. 6d. per foot
	100 ft.	per ft.			100 ft.				100 ft.				
POPLAR, of Sorts	7 6	1 2	1 6	2 6	6 0	0 9	1 0	1 4	2 3	0 6	0 9	1 0	Poplars and willows are very variable in price, according to the districts and demand
WILLOWS	7 6	1 2	1 6	2 6	6 0	0 10	1 2	1 6	2 3	0 6	0 10	1 2	

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TABLE B, shewing the different Ages at which Timber Trees grown in Scotland can be most profitably Felled, in different soils and situations.

NAME OF TREE.	Deep sandy loam or clay, drained and sheltered, subsoil clay.	Rich loam, rather damp subsoil, and sheltered situation.	Light loam, rocky or boulder clay, drained, situation exposed.	Thin gravelly soils, coal and lime formation, situation exposed.	Dry, gravelly, and sandy soils, dry bottom, and moderately sheltered.	Rich alluvial soil, gravelly bottom, and sheltered.	Moss, drained and moderately sheltered.	Clay soils, on sides of valleys or mountain slopes.	Heath or moor soils, granitic formation.	Light open soils, on freestone and whinstone formations.	Retentive clay and wet subsoil, moderately sheltered.	Light or peaty soil, damp moorland subsoil, exposed.	REMARKS.
	Years	Years	Years	Years	Years	Years	Years	Years	Years	Years	Years	Years	
SCOTS PINE	80	100	70	50	60	100	70	60	60	60	50	50	
LARCH	70	80	60	35	...	100	...	80	50	60	50	...	The larch cannot be grown profitably on dry ground or moor soil
SPRUCE FIR	70	70	30	30	...	80	60	40	...	30	50	...	Spruce will not grow profitably if exposed
SILVER FIR	80	100	50	50	60	80	...	80	...	40	50	...	
ASH	40	40	80	40	...	100	30	40	...	40	40	...	Ash grows to an old age, but most profitable when young
ALDER	50	50	...	...	...	50	60	...	...	...	50	...	Alder grows on these soils, but other trees are more profitable
BEECH	100	100	120	120	100	120	...	100	80	100	120	...	Is only profitable when a large size
BIRCH	50	50	60	60	50	50	60	50	60	40	40	50	
ELM (SCOTCH)	120	100	100	...	...	100	...	100	...	100	80	...	Elms are most profitable when grown to a large size
ELM (ENGLISH)	120	100	80	...	...	100	...	80	...	100	80	...	
CHESTNUT (HORSE)...	120	100	...	..	...	120	...	...	...	80	100	...	
CHESTNUT (SWEET) ..	120	70	70	.	...	120	..	100	...	...	80	...	Apt to get ring-shaken in some soils
LIME	100	100	...	...	...	120	...	80	...	...	80	...	
MAPLE (NORWAY)	100	100	100	80	80	100	...	80	...	80	80	...	Grows well in exposed soils
OAK	120	120	120	120	...	150	80	120	...	80	100	30	Must be grown till the heart-wood is well formed, and as copse on moorland soil
PLANE or SYCAMORE	100	100	100	80	80	120	...	100	...	80	80	...	Grows to a large size when sheltered
POPLARS	60	70	50	...	...	30	40	40	...	...	50	..	Poplars and willows generally sell best when of a moderate size
WILLOWS	60	70	50	...	...	60	50	50	...	...	50	.	

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XXIV.—*ON THE CULTURE AND USES OF THE COMMON SILVER FIR, PICEA PECTINATA.*

BY C. Y. MICHIE, FORESTER, CULLEN HOUSE, CULLEN.

THE common silver fir "Picea pectinata" (Picea of Linnæus, but Abies of some other writers), is one of the most picturesque and ornamental of forest trees, and in some cases the most handsome of the Coniferæ. At times it diverges from the beautiful into the picturesque and even grotesque. With all deference to Gilpen's admitted good taste, he has evidently failed in displaying it here, when he speaks of the silver fir in the following strain: "The silver fir has very little to boast in point of picturesque beauty. It has all the regularity of the spruce, but without its floating foliage. There is a sort of harsh, stiff, unbending formality in the stem, the branches, and in the whole economy of the tree, which makes it disagreeable. We rarely see it, even in the happiest state, assume a picturesque shape. Assisted it may be in its form when broken and shattered; but it will rarely get rid of its formality. In old age, it stands the best chance of attaining beauty."

The silver fir was introduced from Germany or Switzerland, by Sergeant Newdegate, in 1603, who planted some at his residence at Harefield Park, Middlesex, and which, according to Evelyn's account, became very large trees.

It is a tree that attains to an immense size, both in this and other countries, and grows to 150 years of age under favourable circumstances. We are informed by those travellers who have seen it growing in Switzerland, Germany, and France, that it appears to luxuriate under circumstances similar to the larch, but prefers a rich dry soil, though at times it is found on ground rather poor, but not gravelly. The silver fir is propagated chiefly from seed, which is ripe in November; but it can also be readily propagated by cuttings and layers. We have also seen a considerable number of trees that had been blown down with the wind at different periods, which had struck root in the ground all along that side resting upon it; and this not only with young trees, but with others also exceeding forty years old. The roots also possess considerably more vitality than any others of the coniferous common forest trees, and not only remain longer in a vital state after the tree is cut down, but make an effort to prolong life, as is seen in the exuding resinous matter around the top of the stool, between the bark and sapwood. We never observed any tree actually produce shoots (termed stockshots) in the same manner as hard-wood trees do; but in cases where the tree is cut over at such a height above ground as to leave a few living branches upon the stool, they often produce vertical shoots which would become trees. Another peculiarity of the silver fir must be familiar to most foresters, in its proclivity to produce vertical shoots at any part where an accident or injury has occurred, or when the top or limb is broken off. It is in connexion with this peculiarity of growth that double tops are produced, for it possesses, in common with hard-wood trees, the quality of producing shoots of two distinct kinds, viz., those that grow horizontally and spreading, termed branches, and those that grow upright, and which constitute the stem or trunk. Probably every other tree as well as that of the silver fir possesses that inherent power of producing both kinds of shoots, and only require to be placed under peculiar circumstances in order to develop them; but the silver fir undoubtedly possesses it in a much higher degree, and different from all others of the coniferous class of forest trees, at least the common Scots pine, Norway spruce, and

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larch. Though the larch, it must be admitted, possesses it to an appreciable extent. So different, varied, and even conflicting are the accounts given of the culture and success of the silver fir, that many persons have been induced to plant it extensively to the exclusion of larch, spruce, and Scots pine; while others have been so far influenced on the other side as to have abondoned planting it altogether, each party believing they have sufficient grounds for acting as they do, and are justified in the course they pursue.

Without arrogating too much, we shall endeavour to shew at least some of the reasons for each party maintaining their own views and acting upon them, and how far each is right in going to the extreme to which they go in either direction.

In almost every county of Scotland, very fine specimens of the silver fir are to be met with, growing upon a diversity of soils, and variously situated, both in regard to shelter and altitude. We have seen it grow well upon almost all soils, except gravel. On such gravel at least Scots pine, birch, and larch, will grow tolerably well upon, silver fir appears not to succeed. We have sometimes thought that we knew cases where this rule was violated; but on examining the soil, and especially the sub-soil, we found that, although the surface presented gravel, the subsoil was of clay or sandy loam.

The counties of Moray and Inverness are proverbial for their extent of gravelly and sandy soils, and these counties generally are ill adapted for the growth of silver fir. In corroboration still of this opinion, we met with Lord L., of B—— Castle, a few months ago, and this nobleman, being eminently versed in forestry, entered into a conversation about the silver fir, and his lordship informed us that silver fir does not succeed upon his estates in Inverness-shire, but invariably lose their leading shoots at 10 to 20 feet high, and many fail long before that stage of growth. On further inquiry, we found that the soil, where the failures occurred, was of a gravelly and sandy description, which probably accounted for it.

We know of some fine healthy growing silver firs situated upon very cold and wet clay, and upon such soils they are certainly the finest specimens of any forest trees in their locality.

The counties of Dumfries, Peebles, Selkirk, and Roxburgh, comprise soils at once the coldest and most clayey and wet of any in the country; and yet in each of these counties are to be found splendid silver firs. Take for example those trees in Mainswood, near Durrisdeer, Dumfries, some of which contain 200 cubic feet; or those at Cowhill, near Dumfries, of equal size; on the roadside near Annan; and also at Dumcrieff, near Moffat, all of which are noble trees. Or again, look at those splendid specimens at Stobo Castle, and Dauwick House, Peeblesshire, or those at Oldhouse of Killearn, Riddell, and Borthwick Brae, and also at Stobs Castle, Branxholm, Wauchope, and many other places that might be named. We have remarked that soils, however cold or clayey, do not injuriously affect but rather favour its growth; and we would next glance at the altitudes at which it is found to succeed. These as may be conceived cannot definitely be ascertained; but we know of large silver firs growing at altitudes over 1000 feet, and we are informed by others that they know of them of immense size at nearly 1200 feet altitude. Taking therefore the two circumstances together, coldness of soil, and the extreme altitude at which it grows luxuriantly, there can be no doubt as to the hardiness of the tree in relation to those influences.

In regard to situation, it appears very accommodating, and is found growing well in any. But judging from the appearance of old trees, we are inclined to think it will attain the greatest age and largest dimensions in a northern aspect; and in such, the trees appear less disposed to become forked or double topped, but prolong their upward growth with fewer interruptions; hence becoming taller than in southern exposures.

Having stated several advantages and recommendations of the silver fir, we shall state a few objections to it.

After a minute and careful examination of all the various circumstances connected with

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the culture of the silver fir, we are led to the conclusion that those influences which most injuriously affect it are its liability to spring frosts injuring it, which occur after it has begun to grow, and being then exceedingly tender, it is very apt to be injured by the frost. In addition to frost, there are evidently other influences which injuriously affect the silver fir, it may be exposure to a low temperature, or it may be easterly winds, or other atmospheric influences. This distinctive influence, be it what it may, so far affects the trees of all ages by causing them first to decay on the top and ultimately causing the whole tree to perish, that the magnitude which it has assumed has caused no small alarm and loss to proprietors. This influence, which, in the writer's opinion, is different from frost, whose effects are visible to the eye, is succeeded by the insect popularly known as the mealy bug. And with many it has long been the established opinion that it is the cause, and not the result or consequence of a predisposing cause. It is not, however, essential for our present purpose to know which is the primary and which the secondary cause; but it is, nevertheless, to be deplored that through this influence the culture of silver fir is rendered precarious and uncertain, so much so indeed that many persons have ceased to plant it.

Many silver firs have doubtless been thrown into disease by being planted upon land in a state of cultivation, or in other words, by being manured. The effects of manure upon certain Coniferæ is so hurtful, and often fatal within a very few years, that most people avoid it entirely; but ground is often planted in which both sufficient manure and lime are present to prove hurtful without a ray of suspicion being awakened respecting them; or of the future failure of the plantation, when it occurs, having even a remote connexion with the lime and manure present in the soil when planted. Why one tree should decay and another close by it survive and flourish is a matter involved in mystery; but if we consider that in a plantation of any description there are trees that come early into leaf, and others that are late, differing as much as twenty days or more between the earliest and the latest in foliating, we need not be surprised at the different results that take place throughout the whole period of the trees existence. And in the event of frost being the sole influence which affects the silver fir injuriously, it is easily discernible how the results are brought about. If, for example, a frost should occur a few days after the earliest plants have foliated, they would of course fall its victims, and those later of foliating for that season escape. And, on the other hand, should a frost occur twenty days after the first or earliest plants have unfolded their leaflets, the latest ones in leafing would suffer, while the earliest ones, being to some extent hardened in consequence of being so long in leaf, would, in like manner, escape. A repetition of frosts upon a certain plant may so weaken its constitution as to predispose it to disease; hence frost may produce diseases of which it was little suspected.

So much in regard to the culture of silver fir; we shall next state some of the uses to which it is put, and its general and comparative value as a timber tree:—

1st, In the market for railway sleepers there is no difference or distinction made between those of silver fir, Norway spruce, or Scots pine; the general price for either in the Glasgow and Newcastle market is 2s. 6d. each, for what are termed ten inch sleepers, that is sleepers 9 feet long, 10 × 5. They are seldom required to be die square, but must have a face upon the round side 5 inches broad for the chair to rest upon.

When clean grown, it is sawn into staves and heading; but as it is generally knotty, it is not suitable for that or any other when cut into thin deals, in consequence of the knots falling out, to the detriment of the articles into which it is manufactured.

Boards cut out of old mature trees make excellent flooring, especially for bedrooms. If of heart-wood, and put down dry, nor once allowed to become wet after being laid, the seams or joints are not liable to open as is the case with Scots pine; but the surface being partly very hard where the knots are,

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and partly soft where they are not, causes floors without carpets, or where much traversed over, to wear into holes. Boards or scantling of silver fir do not warp or twist as larch or even Scots pine does; hence, on that account it is very serviceable for water spouts, troughs, cisterns, and such like. It is an excellent wood for any purpose connected with sluices, embankments, or canals, and is specially adapted for making coffer dams.

For roofing purposes there is no home grown wood better adapted, being equally suitable for rafters, joists, beams, and lintels; but its greatest superiority is for soaking, as it does not warp or twist, or spring the nails at the ends or edges, which some other description of wood does; a circumstance which is very hurtful to the roof, as it causes the slates or tiles to get displaced. No wood is more suitable for partitions, especially to cover with paper, as it is not liable to crack and break as Scots pine does, nor is it so liable to worm eat as is the sap-wood of Scots pine. For roofing stables, breweries, dye-houses, and other buildings where the breath of animals or steam very shortly affects the wood with dry rot, silver fir possesses several peculiar advantages, and lasts twice as long or even longer than Scots pine does. It is very well adapted for fencing purposes, especially for posts, and in wet ground remains sound much longer than the sap-wood of Scots pine. It is not so suitable for rails (especially top ones) as for posts, as it is apt to break at the knots; but where the wood is clear of knots, and of moderately slow growth, it makes excellent rails for all except the top, which should be of larch. In manufacturing silver fir, it is advisable, as far as practicable, to convert it into scantlings as large as possible, which avoids breakage at the knots.

From all we have seen of the silver fir, we conclude, that as heavy a crop of it can be grown per acre as of any other description of wood. For example, we to-day examined a group of silver firs and found them growing at an average distance apart of 12 feet, and each tree, on an average, containing 30 cubic feet of timber, thus making the value of the crop at the following rate per acre :—300 trees multiplied by 30 gives 9000 cubic feet, which, at 6d. per foot, is £225. The age of the trees is about eighty years, and they appear to be quite sound and healthy. We know of no trees which, upon the same description of ground, and within the same period of time, would produce so many feet of timber, save perhaps the black Italian poplar, and the Austrian and Corsican firs; but the rapidity of its growth entails a great profusion of branches which, as a consequence, produces coarse and knotty wood. A valuable crop, however, and probably the most so of any would be, say 500 trees per acre, which would necessitate such proximity of the trees to each other as to prevent undue development of branches; hence wood of finer grain and smaller, if not fewer knots. The Norway white wood, which corresponds with our spruce, is, as may be seen in the boards, thickly but irregularly dotted all over with knots; but these being small do not injuriously affect the value or quality of the wood. If, however, they were two or three times larger than they are, the wood would be of proportionately less value.

REMARKS.

1. The silver fir may be planted as a mixture amongst hard-wood trees, or rather in groups, or single trees at wide distances apart amongst them, to form a contrast at once bold and striking amidst the rounded cloudy tops of the hard-woods.

2. It is a tree very productive of branches if allowed room to develop them, and these in turn produce coarse grained and knotty wood. On the other hand, if much confined, it is apt to contract certain diseases on the top, which dies down several feet, and sometimes causes death to ensue.

3. Its tendency and liability is to blow down with the wind, in consequence of the immense quantity of branches with which it is usually clothed.

4. The great expense of the plants compared with those of Scots pine, larch, or spruce, and tardiness of growth during the first eight or ten years.

5. The comparatively low prices derived for the wood in market compared with many

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other trees that might grow upon the same soil, and occupy similar space.

6. Its liability to contract diseases, some known, others unknown, but all beyond control, and some fatal.

7. Though personally the writer is a great admirer of the silver fir, yet, for general forest planting, he objects to it on the preceding and following considerations: they are, when planting, if he finds soil adapted to the silver fir, he plants other trees upon it more certain to grow, and likely to pay better when grown.

8. One great objection to the silver fir in the present day is, its great liability to be destroyed by rabbits and hares, which are exceedingly fond of its bark, and prefer it to Scots pine, larch, and spruce. We have seen the silver firs selected and destroyed in the midst of those above named without their being at all injured.

9. Another objection to the silver fir is, its tendency to become forked and divide into several stems, which the wind so acts upon as to break off. These must either be pruned off at considerable expense, or left on to the injury of the tree.

10. The knots of the silver fir are so excessively hard as to injure almost any sort of tools, and carpenters object to it on that account. The woodmen dread it for their axes, the sawyer for his saws, and the carpenter for his planes and other tools.

11. The knots being so excessively hard, and the other part of the wood moderately soft, it on that account wears into holes which, in floors, are highly objectionable.

12. In consideration of all the objections to the silver fir (not ignoring its good qualities), we are personally in favour of planting in its stead Picea Nordmanniana, a tree much resembling the common silver, possessing all its good qualities and avoiding its bad ones, save that its plants are for the present probably six times dearer, but will, it is anticipated, gradually become cheaper.

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XXV.—*ON THE VARIOUS KINDS OF TREES AND UNDERWOOD BEST SUITED FOR PLANTING WITHIN THE INFLUENCE OF THE SEA-BREEZE ON SEA-COASTS OR ISLANDS.*

BY WILLIAM GILCHRIST, FORESTER, CLUNY CASTLE, ABERDEEN.

SOME extensive plantations have recently been formed, both in England and Scotland, on barren tracts within the influence of the sea-breeze; and our Continental neighbours have also taught us a great lesson in the indomitable perseverance with which they have overcome so many difficulties and succeeded in the planting of barren tracts and sandy wastes, where the soil was of the poorest description, and considered altogether unfit for the growth of any vegetable product. The providing of artificial shelter by forming screen-fences, sowing tree seeds, and then thatching the ground with branches; or sowing broom or whin seeds along with the tree seeds, so as to shelter the seedling plants, have been some of the chief causes of success, especially where the soil was light and inclining to drift-sand. About five years ago, on the west coast of Ayrshire, I saw a plantation on soil of this description. It consisted chiefly of Scots pine; where it was fully exposed to the blast there was not half a crop of trees on the ground, and these were either drifted up with sand, or their roots were left almost bare of soil. The trees appeared to be about ten years old, and what of them were growing appeared to be in a healthy condition. Had screen-fences been erected on the exposed parts of this plantation, there is no doubt but they would have prevented the sand from drifting so much, and the plantation would by this time have been providing shelter to the adjacent lands, and forming a very prominent object in the landscape.

The soils along some parts of the sea-coast are sometimes found to be very suitable for the growth of trees and shrubs, and in such places there is little difficulty in growing any of the hardy trees, and even some varieties that do not stand the frost inland are found to grow well along these favoured shores; especially is this the case along the shores of Inverary, Lochgilphead, and Loch Fyne. This is principally owing to these places being sheltered from the cold western blasts of winter and spring, by the range of hills lying between them and the main ocean.

One of the most difficult situations for the formation of a plantation on the sea-coast is to be found where the ground is low lying or rising from the shore with a gentle slope, and at the same time exposed to the full force of the ocean-breeze. The difficulty can only be overcome by erecting *screen-fences* at such distances as will effectually break the storm and provide shelter for the young plants. These screen-fences should be erected with brushwood; the thinnings of young plantations, broom, furze, or anything of that description, that will make the fence open and allow the wind to pass through it, instead of passing over it, as in the case of turf or stone-dykes. Some of the cheap and hardy varieties of underwood, such as the common elder, sea buckthorn, willows, sloe, thorn, common whin, &c., should all be used. Of course where these or any variety of underwood is found growing naturally, full advantage should be taken of it; but where there is none, it must be provided and planted at from 2 to 2½ feet apart, so as to act as nurses to the young trees which may be planted at the ordinary distance apart. This underwood, though absolutely necessary for a number of years at the first outset, must be always kept in check, so that the trees may have full scope for the development of both roots and branches.

If the soil is light, with a gravelly bottom (as is often to be found on the west coast of Scotland), or dry barren sand, the kinds of

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trees to be planted must be principally of the pine tribe, such as the Pinus Pinaster, P. montana, P. Austriaca, P. Laricio, and Scots pine. Where the soil is loam or peat, with a mixture of sand, and the subsoil inclining to clay, the broad leaved trees may be used, such as the birch, elm, plane, alder, and Norway maple. All these varieties of trees mentioned have been thoroughly tested along the shores of the west of Scotland, and, if properly taken care of, they will in due time form valuable timber trees for which a ready market and a high price can at all times be had. In an exposed situation, such as has been described, where the trees are planted near to maritime residences, chiefly for ornament and shelter, besides the varieties already mentioned, some of the more ornamental trees and shrubs may be used, such as the laburnum, mountain ash, oak, ash, and beech; and for shrubs, the ribes, sea tamerix, hazel, elder of sorts, snowberry, privet, and common lilac. *When* these have succeeded so as to provide shelter, some of the evergreens and finer sorts may be introduced.

To provide shelter for these maritime residences, hedges will be found to be better than stone and lime walls; that is, unless the walls are higher than what it is intended for the trees or shrubs to grow. I have often observed that where the trees grow a few feet higher than the wall, the tops of them grow freely and are regularly furnished, while the branches parallel with the top of the wall appear as if a portion of them had been cut away. This is caused by the blast striking against the wall in full force, the wall being a resisting body through which wind cannot pass, it ascends to the top of the wall with increased velocity, and the higher the wall the greater is the force at the top, and of course its influence on plants is the more destructive. Screen-fences, composed of brush-wood, near to a residence have a bad appearance, and at the best are only temporary; but I have seen them used with good effect during the most severe of the winter and spring months. As before mentioned, the most effective shelter and fence for these residences is a good hedge, viz., a sunk wall or fence with the back sloping inwards, and a hedge on the top planted with sea buckthorn, beech, elder, or blackthorn. These hedges do not altogether resist the sea-breeze, but they tend to prevent it striking with so great force on a given point, and the salt spray is very much exhausted before it passes through a good hedge, and by that time will do no harm to any of the maritime plants.

Where the elevation rises abruptly from the shore and terminates in flat or table land, even though the situation be as fully exposed to the blast as the one previously described, there is little difficulty in forming plantations; for as soon as a few of the harder varieties of plants can be got to grow on the exposed side, so as to provide shelter, any sorts of trees that are suitable to the soil will grow, as the temperature is generally higher in these situations during the winter and spring months than it is in the inland districts.

In regard to the exposure of trees to the influence of the sea-blast, I consider that it is not the blast or sea-breeze, but the sea-air that is so damaging to the trees during the winter and spring months. Climatic influence acts on the vegetable kingdom as well as on the animal, and it is no uncommon thing in exposed districts of the west coast, during the prevalence of westerly and south-westerly gales, to see the windows crusted with salt like frost. When salt is in the air in such quantities as to leave its impression on the windows, it must of necessity be very damaging to the constitution of trees and shrubs. It is well known that salt used in moderate quantities is a very efficient manure, but if overdone, nothing is more damaging to vegetable life.

In speaking of the formation of plantations on the sea-coast, reference has often been made to the failure of the plants that were planted by a very enterprising gentleman on one of the islands of the Hebrides. But too much stress should not be laid upon the failure of that undertaking, as it was done under very adverse circumstances, and at a time when the formation of plantations was not so well understood as they are at present. The undertaking has been a success, in so far

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as it has proved that some trees will grow under the climatic influences of the ocean; and I have no doubt that, had the formation of this plantation been more judiciously and carefully done, it would by this time have been one of the monuments of arboricultural triumphs on the sea-coast. Some of the causes of failure may be here mentioned, such as the unsuitableness of the soil for the growth of any trees, a great part of it being deep moss, combined with a humid atmosphere, which keeps the soil always in a damp and spongy state. Yet, in that soil and situation, Pinus pinaster, maritima, and montana, trees that are said to grow best in light sandy soil, not only kept in life, but for a number of years after being planted appeared to be in good health. Of course none of the plants, except what are on the sides of ravines or some sheltered spots where the soil is more congenial, will ever come to be timber trees; but if they grow so as to provide shelter for the growth of timber trees, a great end will have been gained. Another cause of failure was the extent of the undertaking for one season. The formation of the plantation should have extended over a number of years, beginning with the most exposed parts, and planting such trees and shrubs only as would provide shelter. As soon as shelter was thus obtained, the remainder could be planted, and even some useful timber trees might be introduced into the exposed parts, as they would then be sheltered by the shrubby sorts that were formerly planted. In the absence of this system, screen-fences ought to have been adopted, irrespective of the extent of the plantation. The packing and shipment of the plants in so large a quantity would also be against their future success; for it is a well-known fact, that even in the most favourable districts for growing plants, the shorter time they are out of the nursery ground before planting the better.

Acclimation also exercises a very great influence on plants, whether they be planted inland or along the shores; but more especially would the influence of acclimation be felt on an exposed coast, or a bleak and barren island, where the soil, even at the best, cannot be said to be suitable for the growth of trees. In such a situation, to be successful in the formation of plantations, a home nursery must be established, and the plants grown from seed. Besides this, they must be what is termed "well handled," that is carefully transplanted, so that they may be well furnished both with roots and branches. This is the more necessary, as a number of the trees that are most suitable for growing in exposed situations are what may be termed "sparse" rooters, and are difficult to transplant, even in the most favourable situations. The situation chosen for a nursery should be in an exposed place and not sheltered more than is absolutely necessary for the healthy growth of the plants.

In a report on sea-side planting, for which the Highland and Agricultural Society awarded their gold medal, special reference is made to plantations that have been formed on the northern extremity of the county of Norfolk, at an altitude of from 200 to 500 feet above the level of the sea. The surface is reported as generally being poor and the subsoil a hard ferruginous gravel. The plants used were goat-willow, alder, birch, sycamore, Scotch elm, and two varieties of the Pinus pinaster. The formation of the plantation, including planting and fencing, is reported as having cost upwards of £10 per acre. The success of the undertaking is attributed to the preparation of the ground by trenching 18 inches deep; erecting screen-fences of brushwood, &c., 6 feet high; carefully preparing the plants; having them well furnished with fibrous roots before planting; and having the ground cleaned by hoeing for the first two years after planting.

The cost of the formation of these plantations appears to be very high when compared with plantations formed on the north coast of Morayshire by Mr Gregor, and reported by him as having cost £232, 18s. 7d., for 298 acres, or, on an average, rather less than 16s. per acre. The plants used were Scots pine and larch. However, the writer states that the unusual small expense of these plantations was owing to "the ground being soft, with

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little or no surface herbage, rendered it suitable for small plants, which were planted by the hand-iron, by people in the vicinity much practised in the work, and who could plant an acre each daily, on such ground without difficulty. The plantations were also made at a time when the price of nursery plants was under the usual rate;" and also, that "the expense of fencing these plantations was very small."

In specifying the kinds of trees and underwood best suited for planting within the influence of the sea-breeze, our remarks must be understood as being chiefly applicable to the west coast of Scotland, and none will be recommended but what have been thoroughly tested, either along the Ayrshire coast, the shores of Campbelton, or on the islands of Arran and Bute; and first amongst these, the palm of honour must be awarded to the

PINUS PINASTER and its varieties. This tree was introduced in 1596, and is common throughout Europe and the shores of the Mediterranean. It is generally found in plains near to the sea, and on sandy soils of the poorest description. It has been successfully grown on the coast of Galloway, and on the northern coast of the county of Norfolk, where, as Mr Gregor, in his "Arboriculture," states that "some of the best specimens of the tree in Britain are to be found, standing nearly 80 feet high, with trunks 12 feet in girth. Many such trees stand at Westwick Park, where few other species of trees would become timber." It has also been most extensively used by our Continental neighbours in the successful formation of plantations on the sea-coast, and on large barren tracts of drift sand, where, previous to its cultivation, scarcely any plants of a ligneous nature could be found to grow. Its accommodating nature in regard to soil and situation was also distinctly proved in the success that has attended its introduction to some of the islands of the Hebrides, where, under very adverse circumstances, and in soil entirely uncongenial to its nature, or at best, very different from that of its native *habitats*, it has shewn such symptoms of success as will ensure its further introduction at no distant period. On the Continent of Europe, its wood is principally used for the production of rosin, tar, and turpentine, and for the ordinary kinds of carpentry and fuel. The pinaster has a very strong *tap-root*, which, in loose, dry, sandy soils, descends perpendicularly into the ground, seeking its nourishment and fixing its anchor or stronghold in a strata that is not reached except by some of the broad-leaved trees. This is a peculiarity which makes it, unless frequently removed in the nursery lines, very difficult to transplant successfully; but this very peculiarity is what makes it, above all others of the pine tribe, a suitable plant for barren sands and sea-side planting. It grows very fast, but is rather loose in its habit, and is very often "kneed," or blown a little to the one side; but it very rarely occurs that any of them are uprooted by the storm. One of the varieties of this tree—Pinus Pinaster minor, or P. P. maritima—is said to be hardier than the species. It is chiefly distinguished by the smallness of its cones, and the shortness of its leaves, as compared with the other. It is found growing on the Continent along with the P. Pinaster.

The next in order of rank amongst the pine tribe are the Pinus montana or pumilio, P. sylvestris, P. Austriaca, and P. Laricio. The P. montana is of a low-spreading, bushy habit; a native of Europe; abounds on the Alps, Pyrenees, and other high mountains; was introduced 1779. It stands the exposure of the sea-breeze; but is of little use except to cover the ground so as to produce shelter for the more useful plants. It prefers a dry soil and a high altitude, but will grow on moss, or on calcareous or chalky soils, and at a higher and more exposed altitude than any of the other pines. The Scots pine, P. sylvestris, is also very accommodating as to soil and altitude. The merits of the Scots pine are so well known amongst arboriculturists, that they do not require to be set forth in a paper of this kind. The P. Austriaca, while growing freely on light sand or gravelly soils, will also grow well on wet or heavier soils than either the Scots pine or the Pinaster. However, it prefers a deep

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dry, calcareous sand, and a southern exposure. The Austriaca was introduced from the Bremia forest of Austria in 1835, and is a free-growing, noble tree. It grows freely along the shores of the Firth of Clyde, and many noble specimens of it are to be seen throughout England. For producing shelter or forming a dark background in the landscape, it is unsurpassed. When allowed to grow in an open situation, its branches are wide-spreading and very picturesque. Its timber is strong, tough, and resinous, and in its native country is said to be valuable for resisting the effects of change from moisture to dryness. If this characteristic holds good of its timber grown in this country, it may yet come to be valuable as material for railway sleepers, &c. But for this purpose it is said to be surpassed by the Pinus Laricio, one of the most valuable and fast-growing pines that has yet been introduced. Although introduced in 1759, it has not been so thoroughly tested on the sea-coast as the other pines we have already mentioned; but wherever it has been carefully planted there it has given satisfaction. Being a native of the island of Corsica, where it frequently attains the height of 140 feet, it will in course of time be regarded as one of our best maritime plants. It is very difficult to transplant, and requires a good, open, loamy soil to ensure success. The wood of it is soft and easily wrought, of a whitish colour; the heartwood is darker, and is found to be of very great duration. It is used by the French Government for shipbuilding, and, under favourable circumstances, is fit for masts for the navy in thirty or forty years. I have not seen the Corsican pine planted to any extent along the sea-coast; but specimen plants of it are to be found growing within the influence of the sea-breeze in different parts of the Ayrshire and Wigtownshire coasts, and also on the shores of Campbeltown.

The larch (Larix Europæa), silver fir (Picea pectinata), and Norway spruce (Abies excelsa), are sometimes found growing remarkably well within the influence of the sea-breeze, but they cannot be relied upon unless sheltered by other trees. In fact, the spruce, though growing within the influence of the sea in its native country, seldom attains even to mediocrity in the west of Scotland when exposed to the sea-blast. The American spruces, A. nigra and A. alba, are more to be depended on, but they do not come to be so useful timber trees. Where the soil is suitable for hard-woods, the larch may be grown profitably amongst them; but on exposed sandy soils it will not succeed. The same may be said of the silver fir; but wherever a suitable situation for either of them can be got they should be introduced, as there are some fine specimens of them along the Firth of Clyde, and they soon come to be profitable trees when grown in a suitable situation.

We have given the preference to the pines for planting within the influence of the sea-breeze, in the full assurance that they are the best, both for shelter and profit; but it cannot fail to be observed that the broad-leaved or hardwood varieties of trees form the greater part of the plantations along the west coast of Scotland and the islands we have mentioned. Conspicuous amongst these, and growing where their roots are sometimes submerged in salt water, are the sycamore (Acer pseudo-Platanus), a native of Switzerland, which withstands the sea-breeze better than most trees. It is rarely known to grow one-sided, even in the most exposed situations, where it is often seen standing alone. The Norway maple (A. platanoides) is a native of the west coast of Norway and the shores of the Baltic, where it attains large dimensions, growing close to the sea-shore. The Scots elm (Ulmus montana), when exposed to the sea-breeze becomes a low-spreading tree, of little value for timber, but produces good shelter, and will thrive in almost any sort of soil that is not water-logged. The alder (Alnus glutinosa) is specially adapted for growing in the wet and marshy places along the shore. It stands the sea-breeze well, and has been used as a nurse in dry situations; but for this purpose it is surpassed by A. incana, the hoary-leaved alder, which forms a very handsome tree, and will grow in either dry or moist soils. The birch (Betula alba) is

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one of the most useful trees for growing in exposed situations; but when grown fully exposed to the sea-breeze it seldom attains that graceful weeping form which makes it such a general favourite in landscape scenery. As a maritime plant it is most useful for planting in a dry peaty soil, with a rocky bottom. On the island of Scurba, birches are growing out of the rocks, where they are fully exposed to the ocean-blast. The foregoing (with the exception of the A. incana, which has only been recently introduced) are what we have found to be the healthiest and most suitable trees for growing on the west coast of Scotland, in situations where they are fully exposed to the influence of the sea-breeze; but there are others that are found growing freely in some of the more sheltered nooks. Amongst these are the beech (Fagus sylvatica), common hornbeam (Carpinus betulus), ash (Fraxinus excelsior), and oak (Quercus pedunculata and sessiliflora). The two former are well suited for planting in a mass, or forming hedges; but I have not seen them succeed as timber trees when fully exposed to the sea-blast. They are, however, useful for planting as a mixture with other hardwood trees for shelter, as they retain (when young) their leaves during winter. The ash, when grown in good soil and a little sheltered, forms good timber trees, and ought to be cultivated wherever the situation is suitable. The oak will grow exposed to the sea-breeze; but, unless in very favourable situations, it becomes very "scraggy," and assumes a dwarf habit. If the soil is suitable, it may be cultivated profitably as copse-wood.

The willows also grow remarkably well on some parts of the sea-coast; in fact, they are so tenacious of life that they will grow almost anywhere; but they never succeed and become timber trees on the coast, except when grown in the hollow places by the side of running water. These water "rills" are very common on some parts of the coast; and where they occur, no better situation can be got for the willows. The sorts best suited for timber trees near to the coast are the Bedford willow (Salix Russelliana), Huntingdon willow (S. alba), and the goat willow (S. caprea). Besides these, a great many of the dwarf varieties of the Salix are suitable for growing as underwood.

Some of the poplars are said to grow well on the sea-coast, but I have not seen such success attend any of them as would warrant their being recommended as maritime plants; however, if they are sheltered and the soil suitable, they will ultimately become profitable.

Amongst the underwood best suited for planting within the influence of the sea-breeze must be enumerated a number of the semi-dwarf trees. I will only give the names of these, dividing them into two classes, viz., those that are suited for the general formation of plantations, and those that, though equally hardy, are, by the price that is still charged for them, only suitable for ornamental planting. In the first class may be included the laburnums (Cytisus Laburnum and C. alpinus). Mountain ash (Pyrus aucuparia) is one of the most admirable trees for planting as a nurse in exposed plantations: it will grow in any soil and in the most exposed situations, is a free grower, and forms excellent copse-wood. Common elder (Sambucus nigra), black or sloe-thorn (Prunus spinosa), sea buckthorn (Hippophæa rhamnoides), which is the best of all deciduous shrubs for standing the sea-breeze: it seems quite at home on the shore, and will grow in pure gravel, throwing out its branches to the sea; the hazel (Corylus avellana), common whin or furze (Ulex Europæa), and the privet (Ligustrum vulgare). These, along with the dwarf pines we have mentioned, will produce sufficient shelter and give a very pleasing appearance to a plantation, as compared with the bare-stemmed, stunted-looking trees that are so often to be seen along our shores.

The ornamental shrubs for sea-side planting are the bird cherry (Cerasus Mahaleb), the tamarisk (Tamarix), French tamarisk (T. gallica), common lilac (Syringa vulgaris), evergreen oak (Quercus Ilex), snowberry (Symphoricarpus racemosus), common holly (Ilex aquifolium), Laurustinus (Viburnum Tinus), red-flowering currant (Ribes sangui-

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neum), the common Arbor Vitæ (Thuja occidentalis and T. Warreana). Besides these, specimens of the Araucaria imbricata, Cedrus Deodara, Wellingtonia gigantea, Cupressus Lawsoniana, and Nutkaensis, and others of the same class, are occasionally to be met with growing freely on the sea-coast; but they cannot be recommended except where shelter is provided, either natural or artificial.

The Portugal and common laurel, Rhododendron ponticum and its varieties, are also often planted, but do not succeed unless sheltered.

Before concluding this paper I would beg to offer a few general remarks regarding the cultivation of plantations on the sea-coast and islands; and, first, the preparation of the ground. If rank whins or heath are growing on the surface, they should be burnt down; whins one year before planting, and heath at least two years. This is better than trenching, as the natural whins and heath provide shelter for the young plants; only, the whins must be kept in check, so as not to injure the young trees. Hard, "benty" ground on "links," with coarse herbage, ought to be trenched at least 18 inches deep, and the surface "spit" put into the bottom of the trench. This should also be done a considerable time previous to planting, so that the ground may have time to consolidate. Deep mossy or peat ground should also be trenched, and, if possible, some of the under strata (be it clay, sand, or gravel) brought to the surface. If this is not practicable, sand or gravelly soil should be got and added to the surface, so as to give the plants a fair start. Where the ground is wet, it must be thoroughly drained before planting, as nothing is so injurious to plants as stagnant water. On drift-sand or sloping banks, much exposed to the sea-breeze, screen-fences must be provided. The plants must be well rooted, hardy, healthy, and, if possible, reared in the neighbourhood, and kept as short time out of the ground before planting as possible.

Planting operations ought to be done in the months of October and November, or March and April. In the case of mossy ground it is absolutely necessary that the planting be not begun before the latter end of March. Where the situation is exposed, plant close and thin, early and often. Prune the hardwood trees when young, so that they may grow compact, and not be liable to have their side branches lashed or broken with the wind. Keep the young trees at all times clear of brushwood or whatever tends to prevent a free current of air from passing through amongst them. This last is of the utmost importance, for unless trees are grown open and allowed to spread their branches, they will never spread their roots; and when the storm comes in all its fury, they become an easy prey to its ruthless blast.

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XXVI.—*ON THE VARIOUS KINDS OF TREES AND UNDERWOOD BEST SUITED FOR PLANTING WITHIN THE INFLUENCE OF THE SEA-BREEZE, ON SEA-COASTS OR ISLANDS.*

BY C. Y. MICHIE, FORESTER, CULLEN HOUSE, CULLEN.

TO plant with a view of growing trees successfully and profitably within the influence of the sea, where the wind passes unbroken over a large surface of water, such as the coast of Aberdeenshire and Banffshire, is an undertaking which few would risk. But as comparative rather than absolute success is what, under such circumstances, is looked for, the observation and experience of one who has both failed and succeeded in such works may be of some interest.

We have been induced to visit almost every important part of our Scottish and English coasts, and see "that we might believe" regarding the success or failure of all plantations, shrubberies, bushes, or hedges, so situated as to be under the free and full influence of the sea-breeze. We were assured by one party that the Pinus Pinaster was to be found growing luxuriantly in the open mouth of the German Ocean, along the coasts of Aberdeenshire and Banffshire; but on examining all parts exposed we found no such trees growing even moderately; and all that remained was a few of the lower branches, supported by a weather-beaten stem without a top, only a few inches high; and neither tree nor shrub made any pretentions to growth beyond a bare existence.

Not long ago, a writer to our local papers, in a lengthened article upon plants which luxuriate in maritime situations, described the sea buckthorn (Hippophæa rhamnoides) as growing at Dunrobin Castle, in Sutherlandshire, close upon the margin of the sea, even laved by its surging waves. Not having seen it grow as there described, we made a tour so as to include this interesting sight, and try to ascertain why the sea buckthorn should grow there almost bathed in briny water, while under our own care a full hundred yards from the sea, it scarcely grows at all. The secret we found to be, that while the situation of the sea buckthorn under our own charge is fully and keenly exposed to a great breadth of the German Ocean, the beautiful and luxuriant groups at Dunrobin are completely sheltered from the destructive prevailing winds of the ocean.

Some years ago, we were told of the successful growth of sycamore, ash, and Wych elm, upon the sea-coast, down to the water's edge at high tide, between Inverness and Beauly. Not having seen trees grow as thus described, we anxiously looked forward to the time when we could witness for ourselves. The time did arrive, and we examined with no small interest and delight a beautiful belt of hardwoods, extending, as we described, close along upon the shore, in excellent condition and vigour of growth. It, however, required only a glance of the eye to see the producing cause of this, viz., the shelter afforded by the Black Isle on the other side of the Firth. In proceeding farther north, the fine growth of the woods and plantations surprise those who have not hitherto seen them, and all along the coast side where trees or shrubs have been planted, down even to the edge of the water, they are growing vigorously, owing no doubt to the modifying and ameliorating effects of the surrounding islands and promontories.

When Nature has withheld her favours for the growth of trees upon the sea-coast, Art may be called upon to aid the deficiency. Take the following by way of example:—There is a farm-steading within three-fourths of a mile of the Moray Firth, in Banffshire, where the tenant, disliking the exposure, and anxious to rear a plantation to shelter it, planted a group of trees around his premises,

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comprising the common sorts of forest trees, both deciduous and evergreen. Year after year he continued to plant, in consequence of the deaths that annually occurred, but without success, till some person suggested to him to trench the ground. The proprietor was applied to and consented to do this part of the work, which was soon executed, and the ground once more planted with the same description of trees; and the results have been, that the trees, from the time of trenching the ground, grew well, and so continued growing; and many of them are at the present time equal in size to those farther inland of the same age. The writer thinned the plantation in 1867, and found the trees both in a healthy and prosperous condition, the only defect being want of lateral branches, from the trees being in many cases too much drawn up, the result of want of early thinning. The outside row of trees exposed to the north (or sea-side) were considerably affected by the sea winds, being bent towards the land-side, assuming a cowering attitude, stooping as if to allow the blast to pass over them. The list of trees of this plantation comprised Wych elm, lime, ash, oak, sycamore, birch, and white poplar, together with Norway spruce, larch, and Scots pine. The sycamore is decidedly the most prosperous of any, and next to it in succession the ash, elm, oak, poplar, birch, lime, Scots pine, larch, and spruce. There is also a hedge of elder surrounding the plantation inside of a post and rail paling. The hedge has uniformly continued healthy and growing, and requires constant trimming to keep it within due limits; and to it, there is no doubt, the trees were indebted for the shelter afforded them when young.

It cannot be said that this plantation is so close to the sea as fairly to indicate the sorts of trees best adapted for maritime planting; but it shews at least that while no plantation could be reared before the ground was trenched, it succeeded well afterwards. Thus manifesting, that while the influence of the sea-breeze is such as to prevent the trees from making headway on unfavourable soil, it fails to check their growth when the soil is rendered loose and suitable.

Another example of a different kind may be cited to shew the effects of the sea-breeze, after passing over a large expanse of ocean, and beating without interruption or impediment upon a bleak exposure, entirely void of shelter. A fine grassy bank skirts the sea-shore at Port-Cullen, in Banffshire, which the proprietor was desirous of planting, to form a protection to his magnificent policy grounds lying behind. A forester of considerable note was consulted upon the subject, who recommended planting it with Pinasters, which was done, and several times repeated, but without avail. Other descriptions of Coniferæ were also tried, including Pinus Austriaca, Pinus Laricio, larch, and native Scots pine, but they all shared the same fate; and now (12 years subsequently) the larch is the only plant visible upon the ground, and only that part of it is vital which is partially covered with the rank herbage; but the top and leading shoots, as they begin to advance, are met with a gust of sea-air, which renders them as brown and dead as if burnt by fire. This bank, be it observed, is very abrupt, and about 150 feet in height, with the ground sloping to the sea, so that no shelter could be afforded by one tree to another till they had at least risen a few feet high. The base of the bank is only about 100 yards inland from the sea at high water; so that during a storm the spray is seen and felt upon the face and hands.

The project of planting having completely failed, after a fair trial with Coniferæ, and as winter shelter was only what was required, deciduous trees were not tried, which, although unlikely ever to become more than bushes, would undoubtedly have succeeded better than the evergreens. In the meantime, however, the scheme is abandoned, and the ground laid out for sheep pasture.

At a short distance from the bank above referred to, an ornamental cottage was built, which it was thought desirable to beautify, if possible, with some sort of trees or shrubs. Observing the failure of those upon the bank near by, it was thought advisable to try some other description of plants. A considerable variety of shrubs were planted, including

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Mahonia aquifolium, Spiræa adiantifolia, snowberry (Symphoricarpus racemosus), sea buckthorn, (Hippophæa rhamnoides), elder (Sambucus nigra). On examining the shrubbery at the present time, I find the sea buckthorn doing better than all the others; it has fewer dead branches upon it, and its foliage is more perfect and healthy. The elder, which was planted to form a screen to the other plants, has accomplished all that was anticipated of it; and although there are some dead branches upon it, yet the profusion of strong and vigorous shoots are such as to atone for all minor defects. The Spiræa and snowberry are of about equal growth, and shew great hardiness and adaptation for such exposures; but when choice can be made, it is better to select the more robust sorts for the most prominent and exposed parts, and those less vigorous for subordinate and more sheltered places. Whether from soil or severe exposure, the others did not succeed so well, probably owing to the tenacity and clayey nature of the soil. It was not adapted to the mahonia, and some other plants known to prefer a dry light soil.

In the same locality as the cottage and bank referred to, and distant from the sea about 150 yards, is a plantation of large extent, and about forty years of age. Along the north side of this plantation, and between it and the sea, extends a stone-and-lime wall, about 9 feet high. The trees inside the wall grow well till they reach the top of it, when, straight and level, as if cut with a pruning-knife, the whole tops are indiscriminately shorn off. Those trees next the wall are shorn level with the cope, and gradually as they recede from it they become taller. The incline of the surface so produced is about 1 to 10, appearing somewhat at a distance like a large flat thatched roof. It is worthy of notice, that no visible difference as to hardiness, or power to withstand the influence of the sea-breeze, is here manifested, every species and variety share the same fate. Hard-woods of every sort, and pines also, equally suffer.

The exposure is so great, and force of wind so strong, combined with the salt spray, that not only is vegetation destroyed, but nails in fences, bands and fastenings of gates, and iron railing are destroyed within a few years. A stone-wall as a protection to trees, where it is intended they should rise above it, is the worst description of fence possible, as the wind is nowhere so powerful and hurtful as just at the top of the wall. In all such cases, when a stone-wall is necessary, and it is desirable to grow trees higher than the wall, it is advisable to erect a light palisade paling on the top, which modifies and subdues the influence of the wind. Trees grown behind a wall suffer on two accounts—first, from the concentrated force of the wind; and, secondly, from the shoots and foliage being (from shelter and confinement) more delicate and tender than in any other situation.

Another example may be cited of a still older plantation than any given (seventy to eighty years old), situated within one mile of the Moray Firth, on the coast of Banffshire. We have several times carefully examined the margin of this plantation exposed to the north or seaward side, with the view of ascertaining which of all the species of trees had best succeeded. The following is the order of health and perfection in which they are found at the present time:—1st, the aspen, or wild poplar (Populus tremula); 2d, the sycamore; 3d, the ash; 4th, the elm; 5th, the oak; 6th, the birch; and last, of deciduous trees, the beech, which unfortunately suffers very severely when a sea-storm occurs at any time during the early part of summer. Amongst evergreens, I find the silver fir by far the most prosperous; in many cases it is twenty feet above all the surrounding trees, and thick in proportion; 2d, the Scots pine; 3d, the Norway spruce. It is here worthy of notice how much superior the silver fir is to the spruce; and, contrary to the opinion of many foresters and planters, instead of being delicate and tender, it is by far the most robust of any tree in the whole plantation, being fully 15 feet above all others.

The writer has frequently been asked to recommend as to the planting of certain unfavourable sites upon the coasts of the Moray Firth; and the following answers to inquiries, after hearing particulars given, may be of some service to those requiring to do such work.

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No. 1. Full exposure to the German Ocean —slope of ground towards the sea—no shelter of any kind, either caused by undulations of the ground or herbage—soil sandy, and shifting by the wind.

Answer.—Such a subject cannot be planted so as to produce either shelter, ornament, or profit.

No. 2. Site of plantation upon a plain, elevated a few feet above high water-mark —soil sandy above, but stiff and mossy underneath—exposure open to the sea northwards—no shelter afforded.

Answer.—Erect a wooden paling 3 to 4 feet high, and between two sets of rails place brushwood to form a screen, 4 to 5 feet high. Along, inside the screen-fence, plant elder, strong well-rooted plants, and cut off their tops to half their original height. Next the screen the plants may be planted, 3 feet apart, and gradually increase in distance apart to 5 feet. The belt of elder may be 20 feet wide or so. The next belt farther landward may be sea buckthorn, planted 5 feet apart, and of a breadth about equal to the elder.

The next zone may be aspen or wild poplar, mixed with snowberry, the former planted 10 feet apart, and the latter between them, of the same number, making the whole up to 5 feet apart.

The next zone may be a mixture of sycamore and mountain ash, if the soil is suitable for growing wood to useful size; but if, on the contrary, it is very sandy and poor, instead of sycamore, the goat willow may be planted amongst the mountain ash. It may be as well to plant the elder in a belt all around the plantation, but less broad at the least exposed parts.

This plantation, be it observed, is recommended only for the sake of shelter and ornament, and may be reasonably expected to fulfil both purposes.

No. 3. Exposure to south-east and northwest, but sheltered from due north—soil generally light loam, but hard and gravelly in places—ground undulating and sloping slightly towards the land side. The surface of the soil is covered with a variety of grasses, which are of some value for grazing; hence, if recommended for planting, profit will be looked for.

Recommendation for planting No. 3.—First, the outside belt on the exposed side may be elder, 10 feet broad, and the plants at the margin planted 2 feet apart, to form a hedge; the second belt to be goat willow, mixed with mountain ash; third zone, aspen poplar and sycamore; and fourth zone, sycamore and oak, and where the soil is good, instead of sycamore, ash and elm may be substituted; the whole ground made up to 5 feet apart. If cover for game is also required, common privet may be intermixed throughout, varying at distances apart of from 5 to 10 feet.

The above plantation is understood to constitute the best for what may be properly termed a maritime or seaside plantation; and the trees and plants of which it is composed are such as to allow a variety of objects to be carried out with it.

The reader will probably feel surprised at no mention being made of Coniferæ, and no place being assigned to any of them. The reason of this is, that the foliage of evergreens suffer so greatly in winter as to cause them invariably to become bare and unsightly, besides presenting at all times a withered and burnt appearance, which is not experienced by hard-woods to any serious extent; and besides, when hard-woods do sustain a blight, which generally happens about or before midsummer, a little judicious pruning soon corrects all that is amiss. If, however, it is found desirable to plant for sake of winter-shelter we would recommend as the best which we have tried or seen, the following, in order:—1st, The best for sake of shelter is the Pinus Austriaca; 2d, Pinus Pinaster maritima; and the 3d, the common silver fir.

Recapitulation of trees and shrubs best adapted for planting within severe influence of the sea-breeze, beginning with deciduous trees, and taking them in their preferential order, and considering them in their adaptation to maritime situations rather than in their usefulness as timber or mercantile value:—

Trees.—1. The Trembling Poplar, Populus tremula; 2. The Goat Willow, Salix caprea;

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3. The Sycamore, Acer Pseudo-Platanus; 4. Rowan Tree, Pyrus aucuparia; 5. Wild Cherry Tree, Cerasus sylvestris; 6. Common Ash, Fraxinus excelsior; 7. The Wych Elm, Ulmus montana; 8. The Oak, Quercus rubra.

Amongst Coniferæ, the following are considered the best to withstand exposure to the sea :—

Trees.—1. Pinus Austriaca, Austrian Pine; 2. Pinus Pinaster maritima, Maritime Pine; 3. Picea pectinata, Silver Fir; 4. Pinus sylvestris, Scots Pine; 5. Pinus Laricio, Corsican Pine; 6. Pinus Douglasii, Douglas Spruce.

Shrubs, in their order of hardiness against the sea-breeze :—

1. The Elder, Sambucus nigra; 2. Sea Buckthorn, Hippophæa rhamnoides; 3. Snowberry, Symphoricarpus racemosus; 4. Spiræa adiantifolia; 5. Mahonia aquifolium, Evergreen Barberry; 6. The Tamarisk, Tamarix gallica.*

In connexion with planting any of the preceding list of trees or shrubs, special attention is called to the state of the ground, which, if unsuitable, must either be improved or failure will be the inevitable result.

* Why are the following omitted?—Scotch Rose, Sweet Birch, and Hawthorn, are native shrubs which grow on the sea-coast; also Pinus pumila, the Huntingdon Willow, &c.—ED.

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XXVII.—*REPORT ON THE MOST ADVANTAGEOUS MODE OF ESTABLISHING AND CONDUCTING A REGISTER FOR FORESTERS, UNDER THE AUSPICES OF THE SOCIETY.*

BY JAMES KAY, FORESTER AND HEDGER, BUTE ESTATE, ROTHESAY.

IN discussing the advantages to be derived from an established Register for Foresters in connexion with the Scottish Arboricultural Society, there are various things which may be adverted to, that are more or less connected with the advancement of such an object.

The Society in its present isolated position is quite powerless in promoting the interests of its members any further than individual effort is concerned. No doubt a Society in its first efforts cannot claim confidence till once it has given evidence of being worthy; but without doubt the time has come when it must be conducted on more extended principles, both for the advantage of its members, and of landed proprietors generally.

Therefore, in order to render it more advantageous, it must be placed on a more liberal and practical basis. True, as an institution for practical forestry, its papers will testify what its members are capable of; still, in these days of science and art, it becomes necessary to have it placed on a corresponding footing with other institutions, both in regard to management and scientific research, so as to be able to account for the nature of cause and effect on sound scientific principles; and shew to the world that it is a Society worthy of its name, and give members and landed proprietors an opportunity of availing themselves of the advantages to be derived from it. Some may say, What has Arboriculture to do with science, or science with Arboriculture? The fact is, there are few, if any, of the sciences but are connected with Arboriculture, for Geology may be termed its foundation—climate, its effects. Botany classifies and arranges the productions of the vegetable kingdom. Chemistry analyzes its productions and producers. Therefore, these subjects should be made part of the practical education and examination in becoming a candidate for a forester's situation. It may not be possible to put the Society on such working ground all at once, but these should be its objects at the earliest opportunity, and, without doubt, the advantages would be great, for it would raise the status of the Society to its most practical and useful results; and would, likewise, be a great advantage to proprietors and others requiring head-foresters and wood managers, if conducted on practical and impartial principles, which ought to be the aim and object of such an Association, so as to give proprietors confidence in being supplied with properly qualified men, and that a qualified man may have an opportunity of advancing his abilities. And, in order to have it carried to a successful issue, I would propose that the following conditions be adopted, viz., a Committee or Board of Examiners, appointed by the Society, for interrogating intending foresters, and a register for such as have passed a successful examination on the different subjects connected with Forestry.

The Board of Examiners to consist of seven members of the Society (not less than five of whom must be present at the examinations), who are known to be thoroughly qualified as botanists or practical foresters, and possessed of a good English education; and for a more practical examination in regard to arithmetic, mensuration, book-keeping, &c., I would propose that a certificated examiner of known ability be engaged for that purpose by the Society, and a fee paid by the candidate for each examination.

The object of having a neutral party for

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the examination of what may be termed the educational part, would be to put the candidate on a more impartial examination, and would therefore shew that the efforts of the Society were conducted on sound educational principles, each part of the requirements being examined and attested by those practically acquainted with the respective branches.

It is needless to say that a Register conducted on sound educational and practical principles is bound to further the interest of practical foresters, and give landed proprietors an opportunity of having the right man in the right place, which is hardly possible with a private register; for very often an applicant may be furnished with a host of certificates, a number of which may be from parties that are not capable of judging, or who know little or nothing about the person, and, from liberal motives to advance each other's interests, may make such certificates a great deal better than they ought to be, thereby deceiving the parties that may employ them.

Further, I would deprecate the very idea of having qualifications bought or obtained by bribery in any way whatever. Such attempts should be made publicly known at the first general meeting, and the person or persons struck off the list of members.

As an illustration of this species of deception (though not in regard to forestry, I hope) the following extract will shew how our Continental brethren award their certificates:—"We are glad to see the public alive to the deceptive nature of German degrees. 'How any sensible man,' says a writer in the *Preston Herald*, 'can even for a moment allow himself to be tempted into the folly of dubbing himself Ph.D., or LL.D., or anything else, by such means as we have related, passes our comprehension. The holders of these purchased humbugs, have not, of course, heard of Æsop. Twenty-five or fifteen pounds are required, not a knowledge of the classical writers. But Æsop tells a story of an ass that dressed itself in a lion's skin, and succeeded admirably in inspiring fear and respect amongst the beasts of the forest. So far so good. But the ass, in an evil moment, determined to roar, but only brayed. It was a very natural thing; it was his own voice, and we are not much grieved that the vanity of the ass was punished by the beasts falling upon him and tearing him to pieces. The moral of the story, as we apply it, can easily be drawn by our readers. To conclude with a suggestion. We would advise all holders of degrees, when they are announced officially, to place the name of their university within brackets, after the degree itself. We should then be able to honour an M.A. (Oxford, or Cantab.), or B.A. (Lond., Dur., or Dub.), and LL.D. (bought). The public could then discriminate between real degrees and shams, and a few years would soon suffice to rid us of one of the most contemptible and absurd practices that we have ever investigated. To clear literature of this taint is the duty of scholars. If they allow it to go on unchecked, they must not be surprised to find the lawful degrees suspected equally with the unlawful ones. They must not be grieved when they find that that which should be an honour, and inspire confidence and respect, is treated only with a cynical sneer."

In regard to the mode of conducting examinations, the Board of Examiners should meet once a-year for the purpose of examining candidates and granting of certificates. The time of meeting might be—say in the month of September, so that the progress of the Register may be brought before the Society at the Annual General Meetings.

The examination to be both written and oral, and the value of the answers should be determined by marks. The Examiners should decide on the number of marks to be awarded by the position of the candidate, the value of his employer's certificate, the rate of wages (as vouched for by his employer), and degree of merit of examination.

The certificates should be arranged under three distinct classes:—First, A first-class certificate for those that have passed a successful examination and are deemed "excellent." Second, a second-class certifi- for those that are deemed "good." Third, a third-class certificate for those that are only capable for an "assistant forester."

The Register Roll to be classed under

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three distinct heads according to the value of the certificates. Head-foresters with a first-class certificate and a salary from £80 to £100 per annum. Second, those with a second-class certificate and a salary of £60 per annum. Third, under or assistant-foresters.

A candidate wishing to be put on the Register Roll as head-forester must be a member of the Society for twelve months previous to being enrolled, and be provided with proper certificates as to character and ability, and of his having been employed for at least five years in working in woods and plantations, and give satisfactory reference in connexion with the various requirements, and pass an examination on the following subjects :—

1. A candidate for a head-forester's situation must have had five years' experience in woods and plantations; and in case of being in various places during that period, not less than twelve months to be counted, and each separate engagement to be certified by a certificate from the respective employers.

2. The candidate must pass an examination in the ordinary rules of arithmetic, book-keeping, timber measuring, and land measuring, such as may be deemed necessary in computing the area of a field or plantation.

3. He must be able to dictate and write a letter, such as may be necessary in transacting business in connexion with woods and plantations.

4. He must also be able to answer any questions that may be deemed requisite, as to qualifications and ability, as a practical forester.

In the event of a candidate not passing a successful examination for a head-forester's situation, if deemed capable, he may be eligible as an assistant-forester.

Assistant or under-foresters will only require to be possessed of a certificate as to character and ability from his employers, also attesting that he has been employed at least two years on woods and plantations, must write a fair hand, and be acquainted with the common rules of arithmetic.

A candidate must specify what salary he wishes to be put on the Register for, and shew that he has passed an examination in the above subjects, all of which must be certified by the respective Examiners appointed for that purpose.

A forester who has been dismissed from his situation through bad behaviour or intemperance, not to be allowed to be put on the list of candidates as a head-forester, but may be eligible as a foreman; and if he should prove himself unworthy of that situation, to be no more eligible as a candidate. But if he should prove himself worthy, and of steady habits for eighteen months after his being dismissed from his former situation, he may become eligible as a candidate for a head-forester's place; but should he prove himself unworthy to his second employer, to be struck out of the list of members and no more eligible.

Further, if a head-forester should prove himself dishonest, to be no more eligible as a candidate, and his name to be removed from the list of members.

In conclusion, I would propose that, in order to have questions definitely put and answered, an examination or text-book containing the full requirements, and also the most approved views on forestry, be compiled by a committee appointed by the Society; and in order that the work be accomplished with the least possible labour, I would further suggest that a selection and revision of the most practical papers already published by the Society be made for that purpose.

Such a book is absolutely necessary to remove any vague or uncertain views on forestry, which must necessarily be the case if every one is left to his own or the wanton opinions of promiscuous writers. Besides, such a book would not only be of advantage to the Society in connexion with the Register, but would also be a public benefit; for it would be a book of standard reference for all connected with or interested in forestry. In these days of enterprise, such an undertaking is sure to be successful, and would be one more step towards raising the Scottish Arboricultural Society in the confidence of public estimation.

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XXVIII.—*REPORT ON THE MOST ADVANTAGEOUS MODE OF ESTABLISHING AND CONDUCTING A REGISTER FOR FORESTERS, &c.*

BY C. Y. MICHIE, FORESTER, CULLEN HOUSE, CULLEN.

IN the following report we shall endeavour to shew that the progress attained by the science of Arboriculture has of late years been such as to render necessary a different and improved mode of choosing or electing to high and important appointments those men on whom devolves the task of advancing the science of Arboriculture. Also, that the tests by which the qualifications of foresters have hitherto been tried are feeble, if not false; and the medium through which they are appointed to situations not unfrequently defective and objectionable; and finally, to shew a new and better plan, by the institution of a Register, whereby many of the evils and failures of the old systems may be superseded by the new.

Comparatively few men of any calling or profession in life, whether from nature, talent, or other favouring circumstances, are found truly qualified for filling, with honour and acceptance, any particular appointment compared with those inversely qualified; hence the necessity for a Register, that through its siftings and distinguishing operations the various classes may be so divided and separated, that all talented and duly qualified men may become not only known to each other, but especially to those whose interest it is to know them in a true and practical way, and thus secure their services.

Amongst the chief objects of the Scottish Arboricultural Society is that of advancing and promoting the science itself by all legitimate means within its province; and as the greatest power at command is vested in those men who devote themselves exclusively to its pursuits, their agency ought to be secured, and every assistance given them in its study and pursuit. And while it is the honour and happiness of many who are rich to drink pleasure at such a fountain as the study of Arboriculture affords, we would respectfully remind them that there are others (not a few) ready and willing to devote themselves exclusively to its pursuits, whose talents would command handsome pecuniary rewards in other occupations; and unless adequate inducements are bestowed, and something like due encouragement given to competent and qualified men, the science of Arboriculture must necessarily remain obscure, and in the rear of other sciences.

With the view, therefore, of bringing duly qualified men into contact with those who require and would appreciate their services, it is proposed to establish an institution termed a Register, under the management and auspices of the Scottish Arboricultural Society.

We shall endeavour, as plainly and concisely as possible, to shew some of the reasons that have led to the proposal to establish a Register, and the advantages calculated to arise to both employers and those wishing employment, from such an institution;—its constitution, membership, and general working arrangements.

1. The first reason we shall assign for establishing a Register is the great amount of delay, waste of time, and expense experienced by both masters and men. To the former, when in immediate want of a duly qualified man, and to the latter, when seeking an employer or situation, neither party knowing where or to whom to apply for guidance in the matter.

2. The practice of advertising in newspapers, though common, is so fraught with all that is disagreeable and unsatisfactory, that many employers who would gladly accept of, and adequately remunerate, a duly qualified man, would rather retain the one they have,

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though *unduly* qualified and unsatisfactory, than undergo the disagreeable labours unavoidably connected with advertising.

3. The present as well as the past practice of choosing foresters for situations is generally done in one of three ways, viz., by correspondence done in writing; by intermediate agency or proxy; and sometimes by personal interview. With regard to the first mode, it is objectionable on account of the *test* of qualification, being based too much on the merits or qualifications of letter-writing; for although the gift or acquirement of writing is by no means at variance with, or antagonistic to good forestry, yet it is so different, and apart from it, as to establish the fact that many men who compose well, in general, and display elegant hand-writing, are unqualified in a true and practical sense. Hence, well written letters, however good and commendable as such, are yet to be regarded as improper tests as to the essential qualifications of practical men.

It not unfrequently happens that one man's principal, if not his only talent, lies in writing, while the talents of another (and as applicable to forestry, by far the most important) consists in observation, energy, perseverance, construction, and handicraft, none of which are either represented or indicated by hand-writing; hence, when engagements are effected through writing, and much relied upon *as an index of qualification*, disappointment is the general result.

Selection by proxy or agency, which is the most common and general of all modes, has several advantages over that of choosing from written applications; but is principally objectionable on account of so few of those who are appointed as agents being themselves thoroughly masters of the art, and conversant with the principles and details of forestry; hence, such agents intuitively select foresters whose qualifications agree with their own ideas and standard, which must necessarily be as often wrong as right, just as their own theory is false or true. In connexion with this mode of choosing foresters, a very general agency employed is that of nurserymen. This medium is of old establishment, and well known to both employers and foresters throughout the country, and both parties have hitherto extensively patronized it.

A very general practice with foresters who fall out of situations, is either to put themselves in communication with nurserymen by correspondence, or to endeavour to secure their influence by going as workmen into their nurseries, so as to be under their eye, and kept in remembrance. The practice of foresters applying to nurserymen to procure for them situations is not only an antient but, in many respects, a useful one, and which we would be sorry to undervalue or despise. The system, however, of nurserymen agency, if possessed of much that is good, is also attended with evil; and without enumerating its disadvantages we shall briefly state that what is now required, both by employers and those seeking employment, is far above and beyond anything which nurserymen, either as individuals or firms, can supply. Doubtless nurserymen are in general more before the public than foresters; and some old-established firms have long maintained such important positions and honourable connexions as to constitute them worthy of the confidence reposed in them in the past; but, as individuals and firms, during the course of time have changed or become extinct, and the demand for skilled forestry becomes more urgent and general, a public desideratum has come to exist which they cannot supply for this country, far less for relationships abroad. The best mode of choosing foresters we shall notice is, by personal interview and conversation, between the employer and the person seeking engagement, which differs only from that of engagement through agency, by the person most deeply concerned, or interested in the transaction, being a party to it. A great advantage gained by the employer acting personally in the engagement is that of self-satisfaction at having seen and conversed with the person with whom he is afterwards to be in contact less or more frequently; and it is an element in human nature to like to choose its own objects, whether of taste or utility.

When employers are therefore sufficiently gifted and duly qualified to discern, discrimi-

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nate, and judge of the man and his capabilities, so far is this mode of choosing good and satisfactory; but as it is frequently the case that the class of employers requiring foresters of high attainments are by no means the most likely to have gone into the details and practical operations of forestry, hence the frequent occurrence of unqualified men passing their examination, and thus obtaining appointments which they were incapable of properly filling.

From the preceding modes, it will be seen how very inefficient all are in accomplishing the end and object they undertake; hence has arisen the necessity for establishing a Register for their better accomplishment.

The Register, which is the new mode proposed, will, we anticipate, possess all the advantages requisite for placing the most deserving and best qualified men first on the list, so as to meet with ready engagements to situations worthy of their abilities, and to receive adequate remuneration for their superior qualifications. It will also classify and arrange its members in such a way that any employer may choose, without difficulty, the sort of man he requires to fill any particular situation, from the highest to the lowest in the list.

By means of the Register, advertising for foresters or situations will be no longer necessary; and the trouble and expense therewith connected be entirely avoided.

The influence of nurserymen will, in the old form, be cancelled, but in the new will be greatly increased, and their responsibility proportionately exalted.

By the Register, those duties usually devolving upon one individual in examining candidates, as to their proficiency, morality, &c., will devolve upon a committee, appointed by, and responsible to the Scottish Arboricultural Society, and which committee will comprise the most experienced and accomplished foresters the Society appointing them can command. The advantages of a committee over that of a private individual, in performing such duties as examining candidates, cannot well be over-estimated.

We have indicated some of the reasons for establishing a Register, by shewing that the present existing system is incapable of accomplishing what is required of it, either as respects employers or those wishing for employment. By the old system, no proper facilities are afforded for properly qualified and deserving men finding their place of merit and desert, under worthy employers, to the prevention of others not so qualified or deserving.

While many difficulties are experienced on the part of persons resident in this country, in finding such men as they require to fill local situations, greater difficulties still are experienced by foreigners in procuring suitable persons for situations abroad; and as the practice of engaging Scotch foresters for Germany, India, &c., is becoming more and more general, facilities must be provided to meet their requirements; and these, it is firmly anticipated, will be found under the registry system, since by it any person, whether at home or abroad, by addressing a letter to the Secretary of the Scottish Arboricultural Society, and therein indicating what salary he is prepared to give, can be provided with the most suitable person to fill the situation which the list of membership will afford, and this at a mere nominal expense.

No plan however well devised, or scheme however complete, but may be shewn to be imperfect; nor is the proposed Register an exception to the general rule in the latter respect.

It is not without regret that we find the adoption of the Register opposed by nurserymen, on the ground that it is calculated to detract from their sphere of influence and power. We would, however, seek to assuage all fears on this point, as the adoption of the Register will not in any important and true sense diminish their influence, but, on the contrary, may, according *as they will it*, add very materially to their influence and honour.

THE REGISTER.

In order to the building of a fabric, it is necessary to have the materials which go to construct it, and before we have an established Register, we must have those essential elements which compose it; and beginning with

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the office-bearers of the Scottish Arboricultural Society as its nucleus, we would proceed as follows:—

1st, The President of the Scottish Arboricultural Society to be its President, if president is required.

2nd, The Secretary, who shall keep the book for enrolment and minutes of procedure, sign certificates, &c., to be the Secretary of the Scottish Arboricultural Society.

3d, The Committee, who shall consist of three members chosen from the list of the General Committee, or appointed at the next annual meeting, to be composed of two practical foresters, and one scientific or distinguished literary man. This Committee to be composed of men residing as near Edinburgh as possible, and who may hold quarterly meetings at a place and time to be afterwards named, for the purpose of examining candidates for registry, examining their testimonials, corresponding with them, and *de facto*, doing everything required in order to ascertain full particulars and antecedents of all persons seeking testimonials of *eligibility for registry*. We would here also recommend that this Committee be invested with power to appoint *other committees* to act in emergencies, especially in distant localities, when the applicants could not, on account of distance, go to Edinburgh to be examined; and such subordinate committees may be either appointed for the year, or chosen only to meet extraordinary emergencies, and thereafter retire. Upon the proper discharge of duty on the part of such committee, or committees, depends in a great measure the beneficial and successful results of the registry.

4th, The members, or persons who are eligible for registry, shall consist of such only as conform to the prescribed rules, which rules may be published along with the Transactions, and separate copies kept and sold by the Secretary to any person who may apply for them.

5th, In addition to foresters, it is also here proposed to open the Register to hedgers, wire-fencers, saw-millers, estate carpenters, rustic wood workers, &c.; but the condition of being a member of the Scottish Arboricultural Society need not be binding on others except foresters.

6th, Persons examined by the appointed Committee, and found *qualified according to their class*, shall convey to the Secretary their respective schedule A (see Appendix), filled up and signed by the Convener of Committee, at sight of which the Registrar shall grant the applicant another schedule or certificate B (see Appendix); and this certificate will require always to be produced, or held as produced by a proxy, when he desires his name put upon the Register.

7th, The certificate given by the Secretary shall enable its possessor to register, without further trouble, at any time within two years from date of certificate; but any person seeking registry beyond the period of two years will, in addition to that of producing his original certificate B, require to produce a supplementary schedule C, filled up according to prescribed form, by two members of the Scottish Arboricultural Society, other than relatives.

8th, A scale of charges will be resolved upon by the Scottish Arboricultural Society, and the Registrar to impose them as personal remuneration for all duties discharged in connexion with the Register, of which the following may indicate the scale:—

1. Certificate signed by Secretary .	0*s*	6*d*
2. For enrolling in Register . .	1	0
3. Letters, one page of note 2d., including stamp, and for each page additional	0	1
4. For each engagement (paid by employer)	1	0
5. For each name or address for reference copied from the Register and sent, in addition to stamp	0	1

9th, It may be left optional to the person entering his name in the Register, whether his own or that of a patron or friend's name, be entered for first reference; by this toleration being given, it will add greatly to the popularity of the institution, by the privacy which it secures; as some persons would prefer the name of a respectable nurseryman, factor, or

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other being placed in the Register in preference to their own being put there. Some persons, on the other hand, would prefer their own name put in preference to that of anyone's else. This, however, being a rule and provision, it prevents any person who might, through mere curiosity or baser motives, pay the required amount for the pleasure of looking into the register to see who were seeking, or requiring situations; but on its becoming known that representative names (for reference) stood there as well as others, few would care to pay for such an indulgence.

10th, Any proprietor applying to the Registrar for a forester or other person requires to state the highest amount of salary he is prepared to give, and on the Registrar receiving such information he at once copies out all the names of that class, including address, and despatches the list to the person applying, leaving it to him to make his selection. The Society being so far a guarantee that every man upon the list is duly *qualified according to his class.* And the person to whom the list is sent pays, in addition to stamps, one penny for each name in the list sent him. If thirty names are sent, he pays 2s. 6d., and so on.

With respect to the persons whom the Register contemplates accommodating and benefiting, we would denominate and classify as follows:—

FORESTERS.

We propose arranging and classifying foresters in four divisions, namely:—

1st, First-class men at minimum salary of £100 per annum.

2d, Second-class men at minimum salary of £80 per annum.

3d, Third-class men at minimum salary of £50 per annum.

4th, Fourth-class men at minimum salary of £40 per annum.

The conditions and rules applicable to each class are as follows:—

First-class Foresters are subject to the following conditions, namely:—

1st, To be a member of the Scottish Arboricultural Society.

2d, To have either been apprenticed at least three years, or as a set-off against this, to have been six years at the business; altogether, nine years of apprenticed, or twelve years if not apprenticed.

3d, To be at least twenty-seven years of age, and in good health.

4th, To produce satisfactory certificates from his present and previous employers.

5th, To produce favourable testimonials from three foresters (other than relatives), members of the Scottish Arboricultural Society.

6th, To give references to other three members of the Scottish Arboricultural Society (not relatives), in order to answer questions put by the Committee, verbally or in writing, as they think proper.

7th, To shew to the Committee all original certificates, and answer any questions relative to their character, &c.

8th, Minimum salary per annum, including house and garden, £100.

SECOND-CLASS FORESTERS.

1st, To be a member of the Scottish Arboricultural Society.

2d, To have been either apprenticed three years, or as a set-off against the apprenticeship, six years at the business; altogether, if apprenticed, six years; if not apprenticed, nine years.

3d, To be not less than twenty-five years of age.

4th, To produce satisfactory certificates from his present and past employers.

5th, To be recommended by two foresters, members of the Scottish Arboricultural Society (other than relatives).

6th, To give references to other two members of the Scottish Arboricultural Society (not relatives), to answer questions to the Committee, verbally or written, as they think proper.

7th, To answer any relevant questions put by the Committee, shew their original certificates, &c.

8th, Minimum annual salary, including house and garden, £80.

THIRD-CLASS FORESTERS.

1st, To be a member of the Scottish Arboricultural Society.

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2nd, To have been apprenticed three years and one year a journeyman (four years in all), or if not apprenticed, to have been at least six years at the business.

3d, To be recommended by one member of the Scottish Arboricultural Society (not a relative).

4th, To give reference to one other member of the Scottish Arboricultural Society (not a relative), who will answer any required questions to the Committee, verbal or written.

5th, To be not less than twenty-three years of age.

6th, To be examined by the Committee and give them satisfaction on all points both as to qualifications and morality.

7th, Minimum annual salary, including house and garden, £50.

FOURTH-CLASS FORESTERS.

1st, To be a member of the Scottish Arboricultural Society.

2d, To have been at least three years at the business or wrought as a woodman.

3d, To be recommended by one member of the Scottish Arboricultural Society.

4th, To be at least twenty years of age.

5th, To be examined by either the principal or sub-committee, and give them satisfaction as to competency for a foreman's duties, or other subordinate appointment.

6th, Minimum salary, exclusive of perquisites, £40 per annum.

II. APPRENTICE FORESTERS.

In forestry, as in other departments of trade and business, apprentices are frequently required; and it has hitherto been a source of difficulty, both to master foresters and young lads who wish to enter the business, to meet with each other in order to form engagements; and it is in consideration of these difficulties and inconveniences that we propose appropriating a column in the register for their accommodation. The conditions of which are as follows:—

1st, To be not less than fifteen years of age.

2d, To produce a teacher's certificate as to scholarship, &c.

3d, To give references to one member of the Scottish Arboricultural Society.

4th, To be recommended by one member of the Scottish Arboricultural Society.

5th, To submit to engagement for a period of at least three years.

6th, To satisfy the Committee, or sub-committee, on all points relating to character, scholarship, &c.

7th, To accept of wages for first year at three-fourths of that paid to the ordinary workmen, and to advance at the rate of 1s. per week annually throughout the term of engagement.

III. HEDGERS.

Hedgers are a class of men whose services are indispensable on almost all important well-conducted estates in this country, and a class with whom considerable difficulty is often experienced in order to get the proper man for the proper situation. Upon one estate the requirements of the hedger are much work, and roughly performed, while upon another it is quite the reverse of this. In order, therefore, to distinguish and set apart, as far as practicable, the two classes, we have so classified them in the register as follows, and appended the following conditions:—

FIRST-CLASS HEDGERS.

1st, To be recommended by two members of the Scottish Arboricultural Society.

2d, To give references to two other members of the above Society.

3d, To be not less than twenty-six years of age.

4th, To produce testimonials from his present and past employers.

5th, To pass an examination by the appointed Committee.

6th, Minimum annual salary, with house and garden, £40.

SECOND-CLASS HEDGERS.

1st, To be recommended by one member of the Scottish Arboricultural Society.

2d, To give reference to one other member of the above Society.

3d, To be at least twenty-two years of age.

4th, To have been at the employment for at least five years.

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5th, To produce satisfactory testimonials from his present and past employers.

6th, To pass an examination by the appointed Committee.

7th, Minimum weekly wages, without perquisites, 15s. per week.

IV. SAWMILL WORKERS.

This is another important class of men, less or more connected with forestry and estate-work generally. Sawmillers, like hedgers, very naturally divide themselves into two classes, each differing in some important respects from the other. Upon estates where foreign, as well as wood of home-growth, is manufactured for important buildings, first-class sawyers are required, and high wages afforded; but upon estates where the sawing is confined chiefly to young wood for pailing purposes, which does not require much nicety in sawing, secondary men may do, at lower wages.

FIRST-CLASS SAWYERS.

The conditions necessary to be attached to the above class of men in order to admit them to the privilege of registry, are as follows:—

1st, To be recommended by two members of the Scottish Arboricultural Society.

2d, To give reference to other two members of the above Society.

3d, To have been eight years at the business, and practised in the sawing of foreign as well as home-grown wood.

4th, To produce testimonials from present and past employers, as to competency, morality, &c.

5th, To pass examination by the general or sub-committee.

6th, Minimum salary, £40 per annum, with house and garden.

SECOND-CLASS SAWYERS.

1st, To be recommended by one member of the Scottish Arboricultural Society.

2d, To give reference to one other member of the above Society.

3d, To have had five years' experience in sawing generally.

4th, To produce certificates from present and past employers, as to competency, morality, &c.

5th, To pass examination by the special or sub-committee.

6th, Minimum weekly wages, without perquisites, 15s.

V. ESTATE CARPENTERS.

This is another class of men whose services are indispensable upon any important estate, in proportion to their usefulness, so are they difficult to procure, at least at the time, by those requiring them. According to the extent of the estate, and importance of the work required, so vary the necessary qualifications of the men; and in consideration of these requirements, we propose to divide them into two classes, with conditions, as follows:—

FIRST-CLASS ESTATE CARPENTERS.

1st, To be recommended by two members of the Scottish Arboricultural Society.

2d, To give references to other two members of the above Society.

3d, To have had ten years' practice at the trade.

4th, To produce satisfactory testimonials from present and past employers.

5th, To pass examination by the general or sub-committee.

6th, Minimum weekly wages, with house and garden, and maintaining his own tools, 20s.

SECOND-CLASS ESTATE CARPENTERS.

1st, To be recommended by one member of the Scottish Arboricultural Society.

2d, To give reference to one other member of the above Society.

3d, To have had at least five years' experience at the trade.

4th, To produce testimonials from present and past employers, as to competency, morality, &c.

5th, To pass examination before either the special or sub-committee.

6th, Minimum weekly wages, with house and garden, and maintaining his own tools, 17s.

VI. RUSTIC WOOD WORKERS.

According as the taste, habits, and require-

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ments of the community vary and change, so with them must change other things, though remote and distant from them. That which may be accepted as good taste now, may be rejected a few years hence, and *vice versa*. In nothing is this more manifest than in the rapid and intensifying desire for rustic ornamentation and adornment, and although iron is made to imitate wood, yet for many purposes the latter is much preferred, and in nothing more so than in seats and chairs, which, when made of iron, are cold and comfortless compared with wood.

The increasing demand for rustic wood work has induced many men to devote themselves entirely to it as a select and distinct branch of business; and it is with a view to bring together those whose mutual interest it is to meet each other at the Register-office, that we have devoted a column to the above class, not deeming it necessary however, in the meantime, to constitute more than one class; and the conditions to be observed are as follows:—

1st, To be proposed by a member of the Scottish Arboricultural Society.

2d, To give reference to one other member of the above Society.

3d, To produce testimonials from present and past employers, as to efficiency, good conduct, &c.

4th, To pass examination either by the principal or subordinate Committee, and receive certificate from Registrar.

5th, Minimum weekly wages, with house and garden, providing and maintaining tools, 15s. to 18s.

VII. WIRE-FENCERS.

Wire-fencing is a branch of business or department of labour, so great and so rapidly increasing, as to attract to itself a great number of men variously and differently qualified. Two important requisites are necessary on the part of first-class wire-fencers, namely, efficiency and neatness; and as the difficulty of finding men possessed of these two qualifications is great, we have, in order to the more readily discovering them, and placing them in such a position as to meet with due encouragement, provided for them a place in the Register. Believing that only first-class wire-fencers would be sought after, and that such only would think of placing their names in the Register, with a view of obtaining a better position, we think it is only necessary to provide for one class, with the following qualifications, namely:—

1st, To be recommended by one member of the Scottish Arboricultural Society.

2nd, To give reference to one other member of the above Society.

3d, To produce certificates from present and past employers, as to efficiency and good conduct.

4th, To pass examination by either Committee.

5th, Wages per week, with house and garden, from 15s. to 18s.

GENERAL REMARKS.

1st, The advantages which the Scottish Arboricultural Society, as such, will derive from the Register are great and manifold. It will increase the number of its members, make the Society more public and better known, increase its influence and power, and gain for it celebrity, by sending forth the best foresters and others in the land to all parts of the world at large.

2d, It will bring men of all classes together, and allow them to interchange sentiments and opinions upon all subjects with which they have to do, and thus stimulate and animate each other.

3d, The advantages of the Register to individuals, cannot, we believe, be overestimated, in so far that the best men will be placed first in the ranks, and thus obtain the best chance and opportunity of obtaining the best and most desirable situations. The small amount of money required to go through all the processes of registry, correspondence, &c., is a great recommendation to many who are in straitened circumstances, and favourably contrasts, in this respect, with the inconvenient and expensive mode of advertising.

4th, The process and forms to be gone through by persons in order to qualify them for registry are studiously made as simple as

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is compatible with the necessary rules of examination, which are designed to test qualifications, character, &c., and with the justice demanded by deserving and qualified men and the public, in restraining and preventing the unqualified and undeserving from entrenching upon ground rightfully denied them.

5th, By the Register there is secured that amount of secrecy and privacy, which most people regard as almost sacred, and which is especially desirable in all such matters as relate to exchange or appointment to situations of trust and honour. So private, indeed, is the registry of persons that any one examining the list could not, by what is seen there, know who the persons are who are in quest of situations, because the address in the Register is only that which is the index by which to know who the person is whom it represents. It may be the name of the person, *bona fide*, who seeks engagement, or it may be the address of a nurseryman, who allows his name to be placed in the Register on behalf of a person so desiring him, who, on being requested by any one wishing to make an engagement of a forester or other, receives the true address; at same time, he whose name is in the Register is held accountable to the Society, to a certain extent, for the character of him whom he represents; and should he fail to give satisfaction, at any time within two years from the time of engagement, such delinquencies are read over as against the proxy, and thus so far detract from his influence in future. On the other hand, as all names of those persons appointed to situations through the Register will be read over at the two succeeding annual meetings, where they give satisfaction, this also is put to the credit of their proxies, and thus just so much enhances their influence in the future.

6th, By means of the Register none but properly qualified men will be allowed to enter situations; hence confidence in the Society will be felt by proprietors, and from them aid and influence will be secured.

7th, The greatest possible despatch can be effected by means of the Register. A servant of any class may be procured and engaged within a very brief time, and at very little trouble or expense on the part of those engaging him.

8th, While the benefits of the Register will be enjoyed by all parties interested at home, they will be no less so by others at a distance or in foreign countries. As in India or Germany, both conservators and foresters may participate in the good. The conservator may apply for a forester and be supplied with the best whom the Scottish Arboricultural Society can command, without labour, inconvenience, or expense, beyond writing a single letter, and perhaps half-a-crown or so, and the forester in Germany or India may, with like ease and convenience, obtain a situation either in this or other countries.

9th, All applications, whether for Registry, or for persons for situations, to be made to the Secretary of the Scottish Arboricultural Society. On the application of persons for registry who have not passed examination, it will devolve upon the Secretary to put them in communication with the Committee's correspondent, and, after passing examination, the Secretary will give them their respective certificates, and which entitles them, not only at once to obtain Registry, but is of itself equally valuable till the end of two years when, as already stated, the certificate will require to be supplemented by the filling up of a schedule (see Appendix C.) by two members of the Scottish Arboricultural Society.

10th, Any person having, through imprudence or misconduct, forfeited his title to Registry shall, according to his class, be again admitted on getting schedule C (see Appendix) properly filled up, so that those who fall need not thereby be helpless or remain cast off.

11th, It may be objected to the preceding conditions, that they are too strict and exclusive; but to this it may be answered that unless there are exclusive clauses, and the Register be upon somewhat conservative principles, the better results of the Register will fail of attainment, and thereby superior men would eschew it, just as inferior ones would enter and enjoy it.

12th, In no case will it be admissible for

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relations, nearer than cousins, to take any part in giving evidence, or in the recommendation of candidates; and if it can be proved that any person is influenced or induced by money or other species of bribery to give evidence for advancing or promoting any candidate, such persons shall be suspended from all privileges of the Registry during the Society's pleasure.

13th, While the certificate held by any member entitles him to Registry as a first, or second, or other class man, he is not bound to register in that class, but is at liberty to do so in any subordinate or lower class than that to which his certificate entitles him, but no members can register in a class higher than that mentioned in the certificate.

14th, The examples given in the appendix as applying to first-class men apply equally to all other classes, save that suspension for misconduct need not be so long exercised upon them.

15th, The convenience of having the whole resolved into classes determined as near as practicable, by the salary they are prepared to accept, is very considerable, as in the case of a gentleman, writing for a forester, stating the salary at between £60 and £70, the third-class list would be sent him to choose from; and should another state the salary at between £80 and £95, or even £99, he would be furnished with the second-class list, and so on with all the others; thus the list is in each case reduced to near uniformity; whereas, were the whole sent at once —including both £100 and £40 men—the last would be too long, and the expense and labour of copying and sending the list would be very objectionable to all parties on that account.

APPENDIX.

THE SCOTTISH ARBORICULTURAL SOCIETY'S REGISTER.

Schedule **A**.

No. 1.—*First-class Foresters.*

August 2, 1869.

We the Committee for examination, and investigation of Candidates applying for Registry, find JOHN JOHNSTON, Forester of Castle Alpine, duly qualified to be registered according to the rules laid down by the above Society.

(Signed) D. B. ROBERTSON,
Convener of Committee.

THE SCOTTISH ARBORICULTURAL SOCIETY'S REGISTER.

August 3, 1869.

Certificate **B**.

No. 1.—*First-class Foresters.*

This is to certify that JOHN JOHNSTON has successfully passed his examination by the appointed Committee, and is found to be duly qualified for admission to the full privilege of Registry as a First-class Forester now or at any time within two years from this date.

(Signed) JOHN SMITH, *Registrar.*

THE SCOTTISH ARBORICULTURAL SOCIETY'S REGISTER.

Schedule **C**.—Supplementary Schedule.

August 3, 1871.

Questions to be answered (*printed form*).

1. Do you know JOHN ROBERTSON, Forester of Castle Alpine? *Ans.* Yes.

2. Have you known him intimately during the past two years to this date? *Ans.* Yes.

3. Is he to the best of your knowledge sober, and has he been so during past two years? *Ans.* I have always considered him to be so.

4. Is he to the best of your knowledge trustworthy as a Forester? *Ans.* Yes.

5. Do you consider him, at the present time, and for two years past, in such a state and condition as to be fully and completely trusted in a post of responsibility? *Ans.* Yes.

(Signed.) JOHN BLACK, Castle Oak.
JAMES WHITE, Castle Ash.

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XXIX.—*STATE OF ARBORICULTURE IN IRELAND.*

BY CHARLES S. FRANCE, FORESTER, POWERSCOURT, ENNISKERRY.

AT a time when Irish affairs of every description seem to be occupying public attention, it has struck me that it might not be uninteresting to this Society to give some information regarding the state of Arboriculture in that country, derived from personal observation.

To do this in a satisfactory way, it will be necessary to advert to the various causes which operate in favour of or against the proper management and extension of woodland in Ireland, and then make a few observations on the system of management generally adopted at the present time.

That Ireland has at some early period been very thickly wooded, is a fact which no observant mind can controvert; abundant proof of this is found in the many bogs or mosses which abound in every county. These mosses are either full of the remains of oak, or, in a great many instances, Scotch fir. In some places full-sized trees of this pine have been found in a good state of preservation; and where whole trees are not met with, evident signs of the species are found in the remains of old stools below the moss, which invariably present a burned appearance, clearly shewing that these vast forests which covered this country many years ago had been ruthlessly destroyed by the fire of an invader, or some internal commotion.

It is very remarkable in examining these bogs, to observe how beatifully nature seems to have suited itself to the soil. Where we find the underlying soil pretty good, and of a rich alluvial tendency, such as in the counties of Kildare, Meath, &c., we invariably find that oak has been the predominant crop. Again, on the high uplands, where the subsoil is poor and gravelly, the Scotch fir seems to have been the aboriginal timber. What a beautiful lesson, therefore, to the arboricultural student! Nature (although she can be assisted by art) is the best guide to perfection in all the cultural sciences.

I am, however, digressing from the subject at issue. What we have to deal with now is, What is the state of Irish Arboriculture at present?

That Arboriculture, as an important part of estate economy, has been completely ignored in Ireland in days gone by, is a circumstance patent to every experienced observer who may visit that country. A few of the reasons for such a state of things may be traced to the following causes.

I have travelled a good deal through various extensively wooded estates, and I must say that, with very few exceptions, I have found the plantations in a wretched state. The question naturally arises, What is the reason for such a state of things? All the answer I can possibly give is, the various circumstances arising from absenteeism, national prejudice, and want of security, which has affected this unhappy country for ages; the true remedy for which, I fear, has not as yet been discovered.

A few of the local circumstances which operate against proper wood management, are as follows:—

On many estates it has been the custom to allow tenants to plant little patches of ground as it suited their own fancy; these trees they registered, and they then became their exclusive property, the landlord having therefore no right to touch them. We are all aware that no good profitable timber can be grown unless the plantation is of some extent; and when we are aware that these isolated patches are not regularly thinned,

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but merely when wood is required for some farm purpose, it cannot be expected that these trees can be very valuable.

Another circumstance which acts very much against the extension of plantations is the nature of the land tenure.

All estates here are divided into what are called "town-lands." On each of these town-lands, there may be five or six tenants, more or less. If in a hilly or upland district, the tenants crop the low and fertile patches, and have a right (by usage) to pasture their sheep on the hills—this is called "*mountain privilege*,"—the consequence therefore is, that when a proprietor wants to plant any of these irreclaimable parts of his estate, he is met by the most active opposition from his tenants, and in a great many cases cannot get hold of the land until he serves an ejectment on them, which, under any circumstance, is very disagreeable.

Again, a great many proprietors, totally blind to the profits accruing from plantations, have only planted patches of their home parks, perhaps with the object of ornament, or as cover for game. These plantations are generally put under the charge of the steward, or, in other words, the farm grieve, who has power to cut down a tree when he requires it for any estate purpose, and fell whatever the proprietor may himself mark or order to be cut down for sale.

This is, as nearly as I can tell, the true state of woodlands in Ireland, as far as my own observations have gone. Proprietors who are anxious to extend their woodlands cannot do so without a great deal of trouble; and those who have them, have been in the habit of looking upon woods more as a gift of nature, to be wasted at will, than as a souree of profitable income.

I am, however, glad to say that I think a new era is on the eve of being inaugurated in the state of Arboriculture in Ireland, as proprietors are beginning to see that it is necessary, in a pecuniary point of view, to engage the services of thoroughly experienced foresters; and many proprietors are extending their plantations very considerably, even under adverse circumstances.

We therefore look forward with pleasure to the time when Irish Arboriculture will be in a position to bear a favourable comparison with that of her sister countries, and when these hills, which at present are bare and sterile, will be covered with magnificent timber, and thereby contribute not merely to her natural beauty, but very materially to her national wealth and commercial prosperity.

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XXX.—*INSTRUMENT FOR MEASURING THE HEIGHTS OF TREES.*

BY JAMES KAY, HEDGER, BUTE ESTATE, ROTHESAY.

I BEG to offer the accompanying sketch of an instrument for measuring the heights of trees or other objects. It is on the principle of the geometrical square, and is very simple and inexpensive.

The following is an outline of its construction:—Draw a square of not less than six inches on the side, divide the sides into ten equal parts, and these parts again into tenths, which will divide the sides into hundredths. Then draw lines through these divisions parallel to the respective sides of the square. In order to render the lines distinct, draw those at the tens in *black*, those at the fives in *red*, and those between the fives and the tens in *blue*. This arrangement will allow the divisions to be easily read off when making an observation. (The lines may be drawn on a piece of cardboard, and fixed on a quadrangular piece of board, furnished with a pair of sights, on the side *c a*, and supported on a staff about four feet long).

It will be seen that the instrument is simply a large square divided into a number of small squares by lines drawn parallel to the sides of the large square. The side *a b* may be termed the base line, or the distance the observer stands from the object, the height of which he wishes to ascertain. The lines perpendicular to the base line are the altitudes or heights. The height of an object is shewn at the part where the plumbline, suspended from point *a*, crosses the perpendicular corresponding to the distance from the object on the base line; and the numbers along the top and bottom shew the number of divisions corresponding to the height that the plumb has arrived at on the perpendicular. In order to prevent confusion, the base line *a b* is marked at every five feet, so that the observer can choose any convenient distance from the object at every five feet, which will be found sufficient for most cases.

The divisions may represent feet, links, or yards; but whatever standard of measure is fixed on for the base line, the altitudes must be understood to be the same.

Though the altitudes extend to only 100 divisions, a height of 200 feet may be measured by drawing the tangents of the heights from one to two hundred feet on the side *c d*. They are marked at every second division in the accompanying sketch.

MODE OF USING.

Select a base line of a length suitable for observing the height of the object, and fix the stand in the ground, then turn the square till the plumbline falls right over the line *c b*; fix the square in this position by the clump screw, and look through the sight and mark the place on the object where the visual ray strikes. This will give the level corresponding to the height of the observer. Next, slacken the clump screw, and elevate the sight till it correspond with the height of the object, when the clump screw is again fastened and the height read off—the plumbline shewing the exact number of divisions on the perpendicular corresponding to the height of the object. The observed height is then added to the height of the part below the level of the observer, which will give the total height of the object.

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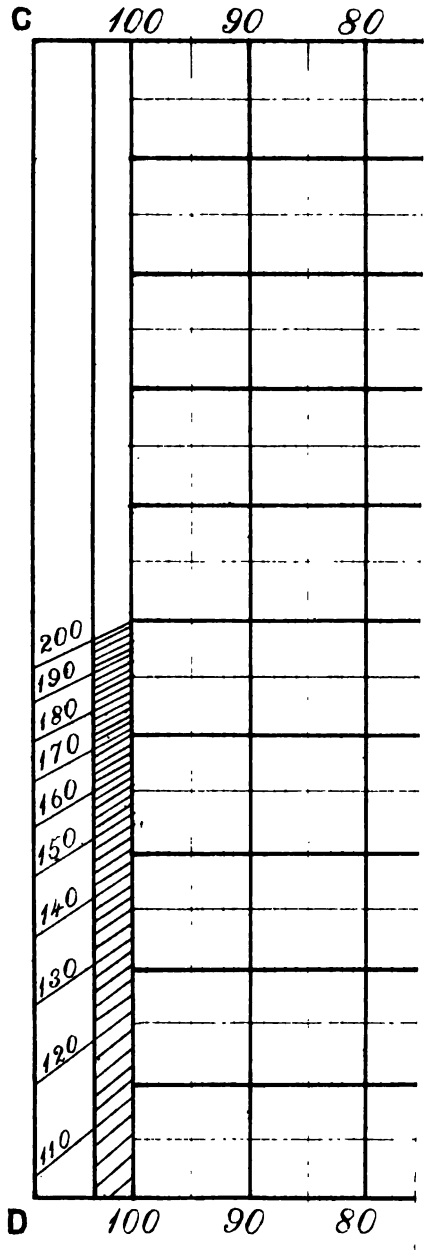

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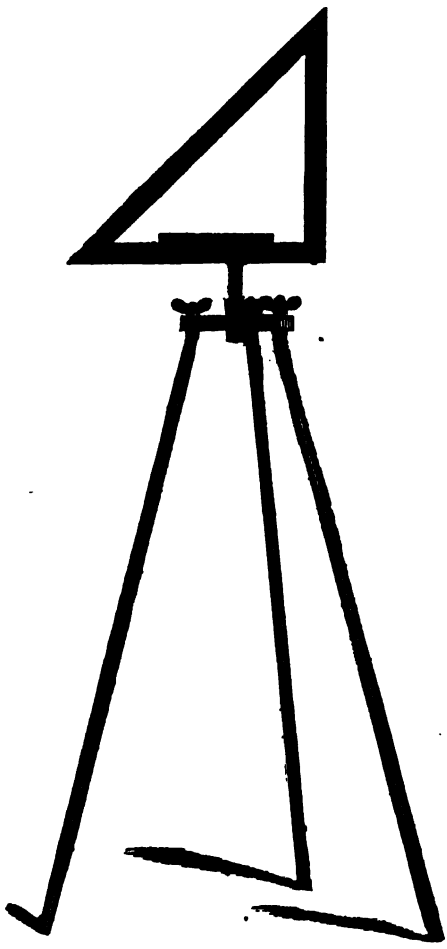
XXXI.—*REPORT ON AN INSTRUMENT FOR MEASURING THE HEIGHTS OF TREES.*

BY WILLIAM BAILLIE, FORESTER, WHITTINGHAM.

THE instrument of itself is so simple, that it requires but little description



to enable any person to understand its construction, and to use it with success.

It is a right-angled triangle of any given square, supported on three legs, with a spirit level attached to the under bar so as to keep the instrument in proper position; and the socket, in which the triangle works, is made to turn half round, so as to enable the instrument to be applied without moving it either the one way or the other in case the hypotenuse is not in the exact line of the object. In placing the instrument to the tree or object of which you wish to ascertain the height, take it back from the trunk until the sloping bar is in line with the top, taking care, at the same time, that the level is properly adjusted. Then look down the bar and fix the eye upon an object on the ground, measuring from which to the base of the tree will give its exact height.

The instrument can be seen at Messrs Dickson & Sons, Seedsmen, Hanover Street, Edinburgh.

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APPENDIX A.

LIST OF MEMBERS,

CORRECTED TO JULY 1870.

** *Honorary Members.* * *Life Members.*

† *Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrear are not entitled to receive the Transactions.

*ADAIR, Sir Shafto, Bart., Flixton Hall, Bungay, Suffolk
ADIE, Alexander J., Esq., Rockville, Linlithgow
AINSLIE, George C., Esq., of Woll, Ashkirk, Hawick
AIRLIE, Earl of, Cortachy Castle, Forfarshire
AITCHISON, William, Forester, Lees, Lanarkshire
ALEXANDER, James, Nursery and Seedsman, Edinburgh
ALEXANDER, John
ALLAN, Andrew, Rankeillor, Cupar, Fife
†ALLAN, John, Forester, Dalmeny Park, Edinburgh
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
ANDERSON, James, Bangholm Nursery, Edinburgh
ANDERSON, James, Meadowbank, Uddingston
ANDERSON, John, Newstead Abbey, Nottingham
†ANDERSON, John, Nurseryman, Perth
†ARCHIBALD, Thomas, Forester (Messrs Dickson & Co.'s Nurseries, Edinburgh)
ARNOTT, Alexander, Forester, East Wemyss, Fife
ARNOTT, Robert A., Mark Lane, London
AUSTIN & M'AUSLIN, Messrs, Nursery and Seedsmen, Glasgow

BAIGRIE, Andrew, Assistant Forester, Abernethy, Strathspey
BAILLIE, William, Forester, Whittingham, Prestonkirk
BAIN, William, Lochrin Iron and Wire Works, Edinburgh
BALDEN, James, Forester, Lennoxlove, Haddington
†BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales
†BALDEN, William, Appleby Castle, Appleby
**BALFOUR, J. H., M.D., F.R.S.E., Regius Professor of Botany in the University of Edinburgh
†BALLANTYNE & SON, Messrs John, Nursery and Seedsmen, Dalkeith
†BARRIE, David, Assistant-Forester, Cortachy Castle, Forfar
†BARRIE, James, Forester, Stevenstone House, Torrington, Devonshire

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BARTER, Frederick, Assistant-Gardener, Powerscourt, Enniskerry
BARTER, Walter, Gardener, Culzean, Maybole, Ayrshire
BATY, William, Forester, Netherby, Longtown
BEGBIE, Harker, Assistant-Forester, Hopetoun, South Queensferry
BELL, James, Strathfieldsaye, Winchfield, Hants
BENNETT, Alexander, Forester
BERRY, George, Longleat, Warminster, Wiltshire
BIRCH, John, Assistant-Gardener, Powerscourt, Enniskerry, Co. Wicklow
†BIRNIE, John, Normanby Park, Brigg, Lincolnshire
BISSETT, David, Forester and Land-Steward, Alva House, Alloa
BISSETT, William S., Land-Steward and Forester, Moncreiffe House, Bridge of Earn, Perthshire
BLACKIE, Alexander, Revesby Abbey, Boston
BLACKLEY, John, Factor, Milton and Castlemilk, Glasgow
BLAIR, Peter, Dunse
†BOA, Andrew, Land-Steward, Dalton House, Newcastle-on-Tyne
BOA, James S. M., Assistant-Forester, Cullen House, Cullen, Banffshire
†BORTHWICK, William, Forester, Dunnichen, Forfar
*BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire
BOTTOMER, Frederick, Gardener, Mackree Castle, Ballisodare, Sligo
BRODIE, James, Land-Steward, Glasslough, Armagh, Ireland
BROUGH, Robert, Forester, Balnagovan, Ross-shire
BROWN, J., Bretby, Burton-on-Trent
BROWN, James, LL.D., Nurseryman and Wood-Surveyor, Craigmill, Stirling
BROWN, James, Carnwath House, Carnwath
BROWN, John E., Craigmill, Stirling
†BROWN, R. E., F.G.S., Estate Agent, Wass, Oswald Kirk, Yorkshire
BROWN, William, Sydney Lodge, Morningside
†BRUCE, Peter, Esq., Messrs Roughead & Park, Haddington
BRUCE, T. R., Esq., of Slogarie, Lawriestown, Castle-Douglas
BUCHAN, George, Forester, Bakewell, Derbyshire
BUCHANAN, Robert, Forester, Dunse Castle, Dunse
BUIST, Matthew, Factor, Tynninghame, Prestonkirk
**BULLEN, R., Curator, Botanic Garden, Glasgow
BURNS, Alexander, Hedger, Glamis Castle, Forfar
BUSSENS, William, Stow Hall, Downham, Norfolk

CALDER, Frederick, Forester, Brucklay Castle, Aberdeenshire
CALDER, R. M., Agent, Myton Hall, Borobridge, York
CAMERON, Hugh, Assistant-Forester, Novar, Evanton, Ross-shire
†CAMERON, John, Assistant-Forester, Glenericht, Blairgowrie
CAMERON, Robert, Forester, Duchal, Port-Glasgow
CAMPBELL, Alexander, Forester, Gray House, Liff, Dundee
†CAMPBELL, James, Esq., of Tillichewan Castle, Dumbartonshire
CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire
CAMPBELL, Peter, Assistant-Forester, Invereshie, Kingussie
CHALMERS, James, Duchal, Port-Glasgow
CHAMBERS, William, Esq., Haford, Aberystwith, Wales
CHAPMAN, James, Forester, Messrs Dickson & Son's Nurseries, Chester
CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith
CHRISTIE, David, Forester, Abington House, Lanarkshire
†CHURNSIDE, Francis, Forester, Ladykirk, Berwickshire
CLARK, James, Forester, Balvaird, Fife
CLARK, John, Dean Park Nurseries, Edinburgh
†CLARK, John, jun., Assistant-Forester, Keith Hall, Aberdeenshire

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†CLARK, J., Forester to the Earl of Kintore, Keith-Hall, Aberdeenshire
CLEGHORN, Hugh, M.D., of Strathvithy, St Andrews, Fife
†CLEGHORN, William, Forester, Ayton Castle, Ayton
COCKBURN, William, Forester, Whitehill, Lasswade
COCKER, James, Nurseryman, Aberdeen
COOKES, Rev. H. W., Astley Rectory, near Stourport
CORBETT, James, Forester, Underley Hall, Kirkby, Westmoreland
COWAN, James, Forester, Bridgend, Islay
COWAN, Robert, Forester, Park, near Paisley
COWE, John, Luffness, Drem
†CRABBE, James, Forester, Glamis Castle, Forfar
CRAIG, Charles, Forester, Warthill, Aberdeenshire
CRAIG, James, Forester to the Right Hon. Lord Blantyre, Erskine, by Glasgow
CRAIG, Nathan, Bangholm Nursery, Edinburgh
CRAIG, Richard, Forester and Gardener, Carlowrie, Kirkliston
CRAIG, Robert, Levens Hall, Milnthrope
†CRICHTON, George, Esq., 18 Princes Street, Edinburgh
†CROSS, David G., Forester, Kylisk, Nenagh, Ireland
*CRAWFORD, William Stirling, Esq., of Milton, Glasgow
CUNNINGHAM, John, Forester, Ardross Castle, Ross-shire
CURRIE, John, Landscape-Gardener, Grange Road, Edinburgh
†CUTLER, D., Forester, Darnaway Castle, Forres

DALGLEISH, John J., Esq., 8 Athole Crescent, Edinburgh
DALRYMPLE, Charles, Hedger, Longleat, Warminster
DANIELS, Peter, Forester, Slindon Hall, Arundel, Sussex
DARIEN, John, Assistant-Forester, Hopetoun House, South Queensferry
†DARLING, John, Forester, St Martins, Perthshire
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DAVIDSON, Jas., Forest Department, Central Provinces, Horhungabad, Bombay
†DAVIDSON, John, Forester, Aldbar, Brechin
†DAVIDSON, J. A., Forester, Belmont Castle, Meigle
DAVIDSON, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne
†DAWSON, John, 21 Princes Street, Perth
DEAN, Richard, Ealing, London
DEMPSEY, Charles, Assistant-Forester, Powerscourt, Enniskerry, Co. Wicklow
†DICKSON, George, Stronvar, Lochearnhead
DICKSON, J., Messrs Edmondston Brothers, 9 Dame Street, Dublin
†DICKSON & SONS, Messrs James, Nurserymen, Edinburgh
DODDS, George, Forester, Cartoon, Maynooth, Ireland
DONALD, Alexander, Assistant-Forester, Ury House, Stonehaven
DONALDSON, J., Forester, Brechin Castle, Brechin
DOUGLAS, J., Gardener, Kilken Castle, Mageney, Co. Kildare
†DOW, Thomas, Assistant-Forester, Powerscourt, Enniskerry, Co. Wicklow
†DOWNIE, LAIRD, & LAING, Messrs, Nursery and Seedsmen, Edinburgh
DRUMMOND BROTHERS, Messrs, Nursery and Seedsmen, Edinburgh
DRUMMOND & SONS, Messrs William, Nurserymen, Stirling
DUFF, James, Factor, Blackwood, Lesmahagow
†DUFF, James, Melgund, Aberlemno, Forfar
DUFF, Thomas, Messrs P. Lawson & Sons, 1 George IV. Bridge, Edinburgh
DUNCAN, John, Assistant-Forester, Ury House, Stonehaven
DUNCAN, William, Forester, Colenden, Perth
DUNN, David, Heaton Park, Manchester
†DUNN, Malcolm, Gardener, Powerscourt, Enniskerry, County Wicklow

EARNSHAW, L., Forester, Morpeth, Northumberland

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EDMONDSON, Thos., Proprietor of "Gardeners' Record," 9 Dame St., Dublin
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ELLIOT, Robert, Assistant-Forester, Abernethy, Strathspey
ELWOOD, Edwin, Assistant-Forester, Dissington Hall, Newcastle-on-Tyne
EWING, Archibald Orr, Esq., of Ballikinrain, Balfron

FENNY, James, Forester, Fetteresso, Stonehaven
*FERGUSON, James, Esq., of Weston, Auchenheath, Lesmahagow
FERGUSON, A., Gosfield Hall, Hallstead, Essex
FETTES, Francis, Assistant-Hedger, Ury House, Stonehaven
FISH, D. T., Hardwick, Bury-St-Edmunds
FISHER, William, Assistant-Forester, Belvair Castle
FOGGO, Robert G., Factor, Invercauld, Braemar, Aberdeen
†FORBES, Andrew, Forester, Stracathro, Brechin
FORGAN, James, Wellwood Cottage, Kinnoull, Perth
FOULIS, Robert, Forester, Fordel, Inverkeithing
FRANCE, Charles, Forester, Culzean Castle, Maybole, Ayrshire
†FRANCE, C. S., Forester, Powerscourt, Enniskerry, County Wicklow
†FRANCE, George, Manager, Glenelg, Lochalsh
FRANCE, James, Assistant-Forester, Culzean Castle, Maybole, Ayrshire
†FRASER, Duncan, Forester, Drumpelier, Coatbridge
FRASER, P. Neill, Esq., Canonmills Lodge, Edinburgh
FRASER, Hugh, Stanwell Nursery, Edinburgh
FRASER, Simon, Forester, Haddo House, Aberdeenshire
†FRASER, Thomas, Forester, Oriel Temple, County Louth
FREEMAN, Timothy, Messrs Osborn & Sons, Fulham, London
FROST, Philip, Gardener, Dropmore, Maidenhead

GALLOWAY, Charles, Forester, Halston Hall, Oswestry, Salop
†GARDINER, R., Wenalt House, Crosswood, Aberystwith, South Wales
GARDINER, James, Forester, Hawkstone Park, Salop
GEIKIE, P. M., Factor, Cortachy, Kirriemuir
GIBSON, William, Nursery and Seedsman, 14 Lower Ormond Quay, Dublin
†GILCHRIST, Andrew, Forester, Ury House, Stonehaven
†GILCHRIST, William, Forester, Cluny Castle, Aberdeen
†GOLD, Joseph, Land-Steward, Murthly Castle, Dunkeld
GORDON, James, Assistant-Forester, Botanic Garden, Edinburgh
GORDON, James, Garnstone Castle, Hereford
GORDON, John, Forester, Durris, by Aberdeen
GORRIE, Archibald, Forester to the Earl of Leicester, Holkham
†GORRIE, William, Rait Lodge, Trinity, Edinburgh
†GOSSIP, James, The Nurseries, Inverness
†GOSSIP, Robert, Crawford Priory, Pitlessie
*†GOUGH, William, Wood-Manager, Wykeham, York
GOW, James, Forester, Camperdown, Dundee
GOW, John L., Factor, Raith, Kirkcaldy
GRANT, Donald, Forester, Drumin, Ballindalloch
*GRANTHAM, George, Esq., Barcombe Place, Lewes, Sussex
†GREIG, Gavin, Forester, Parkhill, Aberdeen
GRIEVE, George, Gardener, Mountstuart, Newtonards, Co. Down
†GRIGOR, John, Nurseryman, Forres
*GRIMMOND, Alex. D., Esq., of Glenericht, Blairgowrie

†HALL, Peter, Forester, Huntly Lodge, Huntly
HAMILTON, David, Forester, Tillichewan Castle, Alexandria, Dumbartonshire

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HANDASYDE & DAVIDSON, Messrs Thomas, Nursery and Seedsmen, Edinburgh
†HARDIE, Walter, Forester, The Hall, Norwell, Newark, Notts
HARDWICK, John, Oyston Park, Grantham
†HARLEY, A., Alloa Park, Alloa
HAVELOCK, Thomas, Forester, Raby Castle, Staindrop
†HAY, James, Forester to the Earl of Seafield, Portsoy
HAYMAN, John, jun., Forester, Dumfries House, Old Cumnock
†HENDERSON, Archibald, Forester, Guisachan, Beauly
*HENMAN, Wm., Forest Department, India, Dingwall Road, Croydon, Surrey
†HEPBURN, William, Assistant-Forester, Lynedoch, Perth
HILL, John, Land-Steward, Whitehill, Lasswade
HOBBS, Harry, Forester, Woodovis, Tavistock, Devon
†HOGARTH, James, Forester, Duthill, Strathspey
HOGG, Thomas, Assistant-Forester, Hampton Court, Leominster, Herefordshire
HOOD, William, Gardener, Glasslough, Ireland
HORSBURGH, James, Forester, Belladrum, Beauly, Inverness
HUME, Andrew, Forester, Fernieherst, Jedburgh
HUME, John Kippen, Forest Department, India, 49 Grange Road, Edinburgh
†HUNTER, Patrick, Assistant-Forester, Erskine House, Glasgow
HUNTER, William, Forester, Castlemilk, Glasgow
HUTCHISON, Robert, F.R.S.E., of Carlowrie, Kirkliston—*President*
*HUTH, Louis, Esq., of Possingworth, Hawkhurst, Sussex
†HUTTON, James, Forester, Moy, Forres

JACKSON, Martin, Forester, Wass, Oswald Kirk
JAMIESON, D., Thoresby Park, Ollerton, Nottinghamshire
JEFFREY, J., Esq., Kirkcaldy, Fife
JEFFREY, John, Forester, Craighall, Blairgowrie
JOHNSTON, James, West Valleyfield, Culross, Perthshire
JOHNSTONE, Alexander, Assistant-Forester, Arniston, Gorebridge
†JOHNSTONE, William, Messrs Dickson & Sons, 32 Hanover Street, Edinburgh
JOSS, John, Assistant-Forester, Crathes Castle, Aberdeenshire

†KAY, James, Forester and Hedger, Bute Estate, Rothesay
†KEDZIE, Walter, Forester, Arundel Castle, Arundel, Sussex
†KEMP, John, Assistant-Forester, Midmar, Aberdeenshire
KENNEDY, Duncan, Assistant-Forester, Erskine House, Glasgow
KENNEDY, G. G. Allan, Assistant-Forester, Cullen House, Cullen
KER, Lord Schomberg, Pinnelhaugh House, Kelso
KERR, Robert P., Nursery and Seedsman, Liverpool
†KINGHORN, Adam, Forester, Rochsoles, Airdrie

LAMBERTON, Hugh, Forester, Blackwood, Lesmahagow
LAMONT, John, Inverleith Nurseries, Edinburgh
LAMONT, John, jun., Inverleith Nurseries, Edinburgh
†LAUDER, William, Forester, Dalton, Newcastle-on-Tyne
**LAWSON, George, Ph.D., LL.D., Dalhousie College, Halifax, Nova Scotia
LAWSON & SON, Messrs Peter, Nursery and Seedsmen, Edinburgh
LEGGAT, Alexander, Assistant-Forester, Cluny Castle, Cluny
*LESLIE, Charles P., Esq., of Castle Lesley, Glasslough, Ireland
LIDDELL, Rev. J. R., The Manse, Kirkliston
LINDOERS, Gavin, Assistant-Forester, Dunglass, Cockburnspath
LINDSAY, Thomas, Bangholm Nursery, Edinburgh
LITTLE, Alexander, Forester, Castle Menzies, Aberfeldy
LORAINE, Edward, Esq., The Riding Mill, Northumberland

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†M'ALISTER, Alexander, Rossie Priory, Dundee
MACBETH, J., Land-Steward, Stobhall, Perth
M'CALLUM, James Thyne, Nursery and Seedsman, 60 Buchanan Street, Glasgow
M'CALLUM, G. K., Esq., of Braco Castle, Braco
†M'CORQUODALE, Donald, Forester to the Duke of Sutherland, Dunrobin Castle, Golspie
†M'CORQUODALE, William, Forester, Scone Palace, Perth
M'CREATH, Hugh, Assistant-Forester, Culzean, Maybole
M'CUTCHEON, Robert, Assistant-Forester, Culzean, Maybole, Ayrshire
M'DONALD, Charles, Gardener, Woodstock, Kilkenny
†M'DONALD, John, Forester, Dupplin Castle, Perth
M'GREGOR, John, Ladywell, Dunkeld
M'GREGOR, Peter, Forester, Ardgowan, Innerkip
†M'HARDY, Charles, Forester, Bellabeg House, Strathdon
M'HATTIE, John, Seedsman, Northgate, Chester
MACKAY, John, Overseer, Cartland Mains, Lanark
M'KAY, James, Forester, Loughcrew, Old Castle, County Meath
M'KAY, Thomas, Forester, Crosswood Park, Aberystwith, South Wales
M'KEITH, Archibald, West Coates Nursery, Edinburgh
M'KELVIE, William Ross, Landscape-Gardener, Cemeteries Office, Dundee
MACKENZIE, Alexander, Warriston Nurseries, Edinburgh
*MACKENZIE, Colin J., Esq., of Portmore, Eddlestone, Peebleshire
MACKENZIE, John Ord, Esq., of Dolphinton, 7 Royal Circus, Edinburgh
M'KENZIE, K. Stewart, Esq., Brahan Castle, Dingwall
MACKINTOSH, R. T., Nursery and Seedsman, Edinburgh
†M'LAREN, Hugh, Messrs Dickson & Co., Nurseries, Edinburgh
M'LAREN, John, Ballencrieff, Drem, Haddingtonshire
†M'LAREN, John, Forester, Hopetoun House, South Queensferry
M'LAREN, John, Forester, Darnhall, Eddleston, Peebles
M'LAREN, Peter, Forester, Altyre, Forres
†M'LAREN, Peter, Assistant-Forester, Stittenham, York
M'LEAN, Andrew, Assistant-Forester, Rutherford, Kelso
M'LEAN, John, Forester, Swainston, near Newport, Isle of Wight
M'LEAN, William, Forester, Eglinton Castle, Irvine
M'LEAY, William, Bestwood Park, Arnould, Nottingham
M'LELLAN, Duncan, Superintendent of Parks, Glasgow
**M'NAB, James, Curator, Royal Botanic Garden, Edinburgh
M'NEILL, James, Forester, Abercairney, Crieff
M'NEILL, D., Timber Agent, Kirriemuir
†M'QUEEN, Alexander, Forester, Castle Grant, Grantown
M'RAE, John, Forester, Carfin House, Motherwell
M'RAE, Robert, Assistant-Forester, Cullen House, Cullen
M'RITCHIE, T. E., Esq., 4 Gayfield Square, Edinburgh
*M'TIER, Alexander Walker, Esq., of Durris, Aberdeenshire
MAIN, John, Assistant-Forester, Ury House, Stonehaven
†MAIN & Co., Messrs A. & J., Wire Fence Manufacturers, 7 Renfield Street, Glasgow
†MARSHALL, J., Forester, Lambton Park, Fence Houses, Durham
MARSHALL, William, Sandhoe, Hexham
MARTIN, George, Forester, Dunecht House, Aberdeen
MARTIN & SONS, Messrs, Nurserymen, Cottingham, Hull
MATHIESON, Donald, Meikleour, Perth
MAXTON, Robert, Forester, Strathallan Castle, Auchterarder
MELROSE, John, Forester, Crathes Castle, Aberdeen
MELROSE, William, Forester, Byram Hall, South Mitford

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MENZIES, William, Forester, New Rattary, Blairgowrie
METHVEN, John, Leith Walk Nurseries, Edinburgh
†METHVEN, Thomas, Nursery and Seedsman, 15 Princes Street, Edinburgh, *Treasurer*
†MICHIE, Christopher Young, Forester, Cullen House, Cullen, Banffshire
†MICHIE, James, Forester, Wemyss Castle, Kirkcaldy
MILNE, James, Assistant-Forester, Cluny Castle, Aberdeen
†MILLER, John, Forester, Gorthie, The Cairnies, Perth
MINTO, Earl of, Minto House, Hawick
†MITCHELL, David, Nursery and Seedsman, Edinburgh
MITCHELL, Forbes, Esq., of Thanestone, Kintore
MITCHELL, James, Aldie, Kinross
MITCHELL, James, Forester, Knossington Grange, Oakham, Leicestershire
MOFFAT, Adam, Forester, Hindlip Hall, Worcester
MOFFAT, Henry, Forester, Middleton, Gorebridge
MOFFAT, James, Forester, Newbattle Abbey, Dalkeith
MORRISON, John, Coney Park Nursery, Stirling
MORRISON, R., Nurseryman, Elgin
MUIR, William, Esq., of Inistrynich, Argyllshire
†MUIRHEAD, John, Forester, Kindease, Invergordon
MUNRO, James, Assistant-Forester, Moy, Forres
MURPHY, William, Leith Walk Nursery, Edinburgh
MURRAY, David, Forester, Dunira, Perthshire
MURRAY, G. W., The Foundry, Banff
MURRAY, Robert, Nurseryman, Lanark
MURRAY, Robert, Forester, Dissington Hall, Newcastle-on-Tyne

NEIL, Archibald, Assistant-Forester, Hopetoun House, South Queensferry
NEILSON, W., Forester, Rimrose Bank, Bootle, Liverpool
NICOL, W., Assistant Forester, Eglinton Castle, Irvine

†OGILVY, David, Assistant-Forester, Cortachy, Forfar
†ORMISTON & RENWICK, Messrs, Nursery and Seedsmen, Melrose

†PALMER & SON, Messrs John, Nurserymen, Annan
†PARKER, James, Forester, Belvoir Castle, Grantham
PARKER, Robert A., Nursery and Seedsman, Lanark
†PATERSON, Andrew, Surveyor, Exton, Oakham, Rutland
PATERSON, William, Gardener, Balmoral Castle, Aberdeenshire
PEEBLES, A., Highclare Castle, Newbury, Bucks
†PHILIP, Robert Sub-Agent, Newnham Paddox, Lutterworth
PIRIE, John, Forester, Blackhall, Aberdeenshire
PORTSMOUTH, Earl of, Eggesford, North Devon
POWERSCOURT, Right Hon. Viscount, Powerscourt, Enniskerry, County Wicklow
PRESSLEY, D., Gardener, Knockmaroon, Chalelizod, Dublin
PRICE, J., Forester, Garnstone Castle, Hereford
†PRINGLE, John, Implement Depot, 1 Victoria Street, Edinburgh

RAIT, James, Forester, Castle Forbes, Whitehouse, Aberdeen
RAMSDEN, Sir J., Bart., M.P., Buckden, Skipton, York
RATTARY, Thomas, Assistant-Forester, Dalmeny Park, Edinburgh
†RAVENSCROFT, Edward, " Farmer Office," India Buildings, Edinburgh
RAYSON, William, Gardener, Doneraile Court, Doneraile, Co. Cork.
†REID, George, Nursery and Seedsman, Aberdeen
†RICHARDSON, Alexander, Land-Steward, Arniston, Gorebridge
RINTOUL, Henry, Dupplin Castle, Perth
RITCHIE, Henry, Eridge Castle, Tunbridge Wells

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†RITCHIE, Walter, Forester, Dinas Mawddwy, Shrewsbury, N. Wales
ROBERTSON, Alexander, Land-Stewart, Powerscourt, Enniskerry, Co. Wicklow
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh
ROBERTSON, James
ROBERTSON, John, Garryland House, Gort, County Wicklow
ROBERTSON, John, Forester, Minto House, Hawick
ROBERTSON, Peter, Land-Steward, Foulis Easter, Dundee
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh
ROBERTSON, Thomas, Forester
ROBERTSON, William W., Forester's House, Lauder
†ROBSON, Alexander, Overseer, Lude, Blair Athole
ROBSON, David, Assistant-Forester, Glenalmond, Perth
ROBSON, John, Forester, Kirby Knowle, Thirsk, Yorkshire
ROBSON, Ralph, Nursery and Seedsman, Hexham
†RUSSELL, John, Craigie, Ayr
†RUTHERFORD, Andrew, Forester, Bowmont, Forest, Kelso
†RUTHERFORD, James, Forester, Linthaugh, Jedburgh
†RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire
RUTHERFORD, Robert, Manager, Invereshie, Kingussie

†SADLER, John, F.R.P.S., Experimental Cottage, Edinburgh.—*Secretary*
†SAMSON, John, Forester, Abernethy, Strathspey
†SANDBACH, Henry R., Esq., Hafodunos, Llanrwst, Denbighshire
SCOTT, Andrew, Assistant-Forester, Newton Don, Kelso
†SCOTT, D., Assistant-Forester, Penrhyn Castle, Bangor, N. Wales
†SCOTT, David, Assistant-Forester, Duthill, Strathspey
SCOTT, John, Forester, Fotheringham, Forfar
†SCOTT, John W., Esq., Delgany, County Wicklow, Ireland
SCOTT, Walter, Forester, Oxnam, Jedburgh
†SCRYMGEOUR, William, Assistant-Forester, Scone, Perth
SEATON, Allan, Assistant-Forester, Cortachy Castle, Kirriemuir
†SIMPSON, J., Forester, Alloa Park, Alloa
SIMPSON, Peter, Assistant-Forester, Wemyss Castle, Kirkcaldy
†SIMPSON, Thomas, Forester, Wolfelee, Hawick
SINTON, J., Stourhead, Warminster
SKIRVING, Archibald, Forester, Kinsham Court, Presteign, Radnorshire
SKIRVING, William, Nursery and Seedsman, Liverpool
†SLATER, Andrew, Forester, Lofthouse, Saltburn-by-the-Sea, Yorkshire
SLATER, A., jun., Assistant-Forester, Upleatham, Marske-by-the-Sea, Yorkshire
†SMART, A. H., Overseer, Carradale, Greenock
SMITH, A., Factor, Douglas Castle, Lanarkshire
†SMITH, James, Forester, Donibristle, Aberdour, Fife
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle
SMITH & SIMONS, Messrs, Nursery and Seedsmen, Howard Street, Glasgow
†SMITH & SON, Messrs William, Nurserymen, Aberdeen
SOLLY, Professor Edward, F.R.S., Parkstone, near Poole
SOMMERVILLE, Samuel, M.D., 17 Hart Street, Edinburgh
†SPENCE, William, Assistant-Forester, Airlie Castle, Kirriemuir
STALKER, Donald, Assistant-Forester
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire
STARK, Robert M., Woodbine Cottage, Trinity, Edinburgh
STEELE, David, Forester, Skene House, Aberdeen
†STEVENSON, James, Forester, Cobham, Park, Surrey
STEWART, A., jun., Assistant-Forester, Ury House, Stonehaven
STEWART, Alexander, Chancelot House, Ferry Road, Edinburgh
STEWART, Alexander, Forester, Morden Park, Surrey
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down

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STEWART, William, Land-Steward, Dalhousie Castle, Lasswade
†STUART, Lewis A. G., Forester, Nethesdale House, Turriff
STUART, William, Forester, Ussie, Dingwall
STUART & MEIN, Messrs, Nurserymen, Kelso
SYME, David, Bangholm House, Edinburgh
SYMON, John, Forester, Cawdor Castle, Nairn

TAIT, David, Forester, Ouston Park, Doncaster, Yorkshire
†TALBERT, Peter, Forester, Glenericht, Blairgowrie
TAYLOR, George, Forester, Monymusk, Aberdeenshire
TAYLOR, George, Nursery and Seedsman, Inverurie
THOMSON, James Scott, Castle Strathallan, Auchterarder
†THOMSON, John Grant, Forester, Grantown, Strathspey
THOMSON, Lockhart, Esq., 22 Coates Crescent, Edinburgh
†THOMSON, William, Deputy-Surveyor, Chopwell Woods, Burnopfield, Durham
THORNTON, Thomas, Heatherside, Frimley, Surrey
TIVENDALE, William, Forester, Houston, near Paisley
TOMLINSON, J., Brocklesby Park, Ulceby
TURNBULL, William, Assistant-Forester, Bowmont Forest, Kelso
TURNER, Robert, Forester, Powerscourt, Enniskerry, Co. Wicklow
TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire

WADDS, Philip, Gardener, Moore Abbey, Co. Kildare
†WARD, James, Assistant-Forester, Powerscourt, Enniskerry, Co. Wicklow
WATERER & GODFREY, Messrs, Nurserymen, Knaphill, Surrey
WATERSON, ——, Assistant-Forester, Scone, Perth
WEAVER, James, Forester to the Marquis of Lothian, Mount-Teviot, Jedburgh
†WEAVER, James V., Forester, Cortachy Castle, Kirriemuir
WELSH, Duncan, Gardener, Mount Merrion, Dublin
†WELSH, James, Nursery and Seedsman, Edinburgh
WELSH, John, Assistant-Forester, Mount-Teviot, Jedburgh
†WELSH, William M., Nursery and Seedsman, Edinburgh
†WHITEFORD, Robert, Assistant-Hedger, Bute Estate, Rothesay
WILD, A. E., Assis.-Conservator of Forests, Punjaub, India, 6 George st., Sheffield
WILSON, John, F.R.S.E., Professor of Agriculture, University of Edinburgh
WILSON, John, Forester, Blenheim Palace, Woodstock, Oxfordshire
WILSON, Robert, Forester, Kelburn Castle, Largs
†WILSON, Robert, Forester, Everleigh, Marlborough
WILSON, Stephen, 132 Union Street, Aberdeen
WOOD, James, Factor, Haighall, Lancashire
WOOD, John, Gardener, Hatton Castle, Aberdeenshire
†WYLLIE, George, Assistant-Forester, Hopetoun House, South Queensferry
WYLLIE, James, Assistant-Forester, Erskine, Bishopton, Glasgow

YELLOWLEES, George, Wood Merchant, Galashiels
YOUNG, John, Messrs Imrie & Sons' Nurseries, Ayr
YOUNG, William, Assistant-Secretary, Royal Caledonian Horticultural Society, Edinburgh

Applications from gentlemen desirous of becoming Members of the Society, to be addressed to Mr JOHN SADLER, Secretary, Royal Botanic Garden, Edinburgh, from whom the Society's Transactions, Copies of the Laws, and all other information, may be obtained.

All Subscriptions and Communications relative to the Society's Financial Affairs to be forwarded direct to Mr THOMAS METHVEN, 15 Princes Street, Edinburgh, the Treasurer.

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Members in arrears will not receive their Transactions, and are therefore requested to obtain their receipts from the Treasurer without further delay.

Members are requested to notify to the Secretary any change in their Address.

Abstract of the Laws of the Scottish Arboricultural Society, as amended to 3d November 1869.

The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical Operations of Forestry, and publication of the same; and by such other means as may be found advisable.

The Society shall consist of the following classes of Members:—1. Proprietors and others, paying an Annual Subscription of Half-a-Guinea; 2. Factors, Nurserymen, and others, paying an Annual Subscription of Five Shillings; 3. Head-Foresters, paying an Annual Subscription of Three Shillings; 4. Assistant-Foresters, paying an Annual Subscription of Two Shillings.

Any Member may become a Life-Member by compounding for his Annual Subscriptions by a single payment; those of the First-Class paying Five Guineas; those of the Second Class, Three Guineas; and those of the Third and Fourth Classes, Two Guineas.

The Society shall elect a limited number of Honorary Members,—gentlemen who have acquired eminence in the science of Arboriculture, or who are otherwise deemed worthy.

All Annual Subscriptions shall be payable in advance, at the term of Martinmas, yearly.

In addition to the Annual Subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his Annual Subscription, be immediately admitted a Member of the Society, subject to the revision of the First General Meeting thereafter. Any Member of the Society introducing a New Member, shall be held responsible for the first year's subscription of such party.

The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and a Committee of fifteen Members—these office-bearers to be elected annually at the General Meeting in November; the three Members of Committee at the top of the list to go out annually, but one to be eligible for re-election.

A General Meeting of the Members shall be held on the first Wednesday of November annually, for the election of New Members, the appointment of Office-Bearers, the reading of Papers, awarding of Prizes, and other business.

JOHN SADLER, *Secretary.*

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APPENDIX B.

GENERAL ABSTRACT OF THE ACCOUNTS OF THE SCOTTISH ARBORICULTURAL SOCIETY FOR 1868-9.

CHARGE.				DISCHARGE.			
1869.				1869.			
Nov.	To Balance due by Treasurer . . .	£0	11 2	Nov.	By Cash paid for Printing	£20	9 9
,,	Subscriptions for 1868-9	50	19 0	,,	,, Engraving	1	17 0
,,	,, of Life Members . .	18	17 6	,,	,, into Savings Bank . .	51	15 11
,	Subscriptions for Sinking Fund . .	26	12 0		Paid Secretary his Salary .	15	0 0
,,	Subscriptions for Arrears	6	7 6	,,	,, Petty Charges	8	14 6
				,,	Treasurer, Postages, and Petty Charges .	3	19 0
					Balance in Treasurer's hand	1	11 0
		£103	7 2			£103	7 2

I have examined the Books and Vouchers, and found them correct.

(Signed) THOMAS METHVEN, *Auditor.*

EDINBURGH, 3*d Nov.* 1869.

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